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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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BRIEFLY TOLD.

THE CLOSING SESSION OF THE FOURTH ANNUAL MEETING, ILLINOIS GAS ASSOCIATION.—These paragraphs respecting the closing day's session of the fourth annual meeting of the Illinois Gas Association came to hand too late for printing in the JOURNAL last week.

CHICAGO, ILLS., March 26th, 1908.

Dear JOURNAL: The second day's sessions of the Illinois Association's fourth annual meeting were convened under the like enthusiastic conditions that prevailed yesterday. The attendance kept up surprisingly well. The business commenced with an important recommendation, embodied in the report of the Committee on Next Place of Meeting, to the effect that the holding of the annual meetings of the Association in any other Illinois city than Chicago was out of the question, and that it was the sense of the Committee that Chicago should be made the permanent place of meeting. The vote in favor of the recommendation was unanimous, and the announcement was vociferously acclaimed. The election of office bearers for the ensuing year was then held, with the following result:

President—Mr. H. L. Rice, Aurora.

Vice-President—Mr. C. H. Quackenbush, East St. Louis.

Secretary-Treasurer—Mr. C. B. Strohn, Elgin.

Executive Committee—Messrs. W. R. Rhoades, Springfield; H. S. Whipple, Rockford; Irwin Rew, Chicago; C. L. Day, Chicago; G. F. Goodnow, Waukegan.

Member, Board Directors, Am. Gas Institute—Mr. J. H. Eustace, Chicago.

The membership was further increased notably by the affirmative action of the Executive Committee on late applications. And here let me say that the glorious event of the meeting next occurred. A motion limiting honorary membership in the Association to a single representative having been adopted, that representative was straightway named, by rising vote, in the person of Mr. J. B. Howard, of Galena. The placing of this recognition upon "Uncle Jerry" was accompanied by an expression of feeling seldom witnessed during the doings of any association connected with advancing the aims of any industry. Indeed the pleasure of the members over this act was looked and voiced in manner beautifully fraternal. "Uncle Jerry" was simply overwhelmed; but not for long. Getting himself together over this unwonted act he bravely responded to the honor in a graceful little speech, the true ring of which endeared him all the more to us, especially in the closing words when he declared it was his earnest wish that each member of the Illinois Association would reach the years attained by "Uncle Jerry." The paper by Mr. C. L. Day, on "Meter Repair Shop Practice," was an interesting and compelling prelude to a discussion that will no doubt be as beneficial later on to your readers in general as it was to the members in particular when they were taking part therein. The last number on the paper list was that prepared by Mr. W. J. Achelpohl, on "Office Methods," and the author was rewarded by a brisk and extended discussion of its many telling points. This really brought the business sessions to an end, and after adjournment, many availed themselves of the hearty invitation extended to the members and guests to visit

LIBRARY OF CONGRESS APR 6 1908 SMITHSONIAN DEPOSIT

the various stations of the Peoples Gas Light and Coke Company, under the guidance of the Superintendents of the stations, which invitation was orally given by Mr. Eustace. The meeting was a most enjoyable one, and many were heard to say, after the gavel had sounded the adjournment, "Well, this makes one think of the palmy days of the well remembered Western Gas Association."—C. H.

CHICAGO, March 27th, 1908.

Dear JOURNAL: The banquet was as enjoyable a function as it was ever my good fortune and pleasure to attend. The "only Eaton" made a royal toastmaster, and the way the banquetters entered into the spirit of the affair made every moment a happy one. The menu, of course, was all that could be desired, the harmonies of instrument and song were in tuneful accord, and the speeches were all right. Notable in the latter was that by Mr. Chas. H. Dickey, of Baltimore, whose remarks were mainly directed to a consideration of Public Service Commissions. Another entertaining matter was Mr. Isham Randolph's recountings regarding the Panama Canal, which were rendered all the more appealable through a series of stereopticon views. About 230 shared in the feast. Take it all-in-all, the Illinois gas men have every good reason to be proud over the records that were made along every line in the instance of the fourth annual meet- of the Illinois Gas Association.—C. H.

PERMANENT ORGANIZATION OF THE INDIANA GAS ASSOCIATION.—Some time ago we noted that several prominent gas men in Indiana had tentatively considered the good policy of forming a gas association in that State. The discussion was productive of so much evidence favoring such formation that a formal call for the organization of the Indiana Gas Association was issued, the meeting to be held in the Claypool Hotel, Indianapolis, the morning of March 27th. Accordingly at 11 A.M. of that date the Chairman, Mr. S. T. Murdock, of Lafayette, called the meeting to order, and those who had originated the plan were well gratified over the number of representative gas men who responded. At the tentative session a committee was appointed on Permanent Organization and instructed to report a constitution and by-laws. These were read and adopted, after which those officers were chosen:

President—Mr. J. W. Dunbar, New Albany.
Vice-President—Mr. W. B. McDonald, Evansville.
Secretary-Treasurer—Mr. Frank K. Lane, Richmond.
Directors—Messrs. Carl H. Graf, S. T. Murdock, B. S. Waters, S. C. Rowland, C. H. Geist and E. A. Wakeman.

There was no particular technical programme offered, although much of the social fraternizing that naturally was carried on during the session brought out many interesting exchanges of opinion regarding legislation, the business outlook and the like this latter seems to be very much to the good all through Indiana. The feature of the session, though, was the courtesy extended to the members by Mr. Carl H. Graf, Engineer and Manager of the Indianapolis Gas Company. At his invitation the gentlemen present made a thorough inspection of the virtually new plant of the Indianapolis Company, which is certainly a model in respect of works' arrangement. And surely it must be a source of great satisfaction to Mr. Graf to know that he has so successfully brought on to full fruition the plans originally devised by that model amongst men—the late Mr. James Somerville. The next meeting date was fixed for the third Wednesday in January, 1909, the place chosen for holding it being Indianapolis. For our facts in connection with this report we are indebted to the courtesy of Mr. F. K. Lane and Mr. W. E. Steinwedell. The Association starts off with quite 40 members.

A PROPOSED SOUTHERN GAS ASSOCIATION.—In January last the following self-explanatory letter was mailed to all gas companies south of Pennsylvania, Ohio and Indiana, and east of the Mississippi river:

ATLANTA GAS LIGHT COMPANY,
ATLANTA, GA., Jan. 15, 1908.

Gentlemen: Shortly before the recent meeting of the American Gas Institute, Mr. J. H. Maxon, Gen. Supt. of the Athens (Ga.) Gas Company, wrote to the various gas companies in Alabama, Florida, Georgia and South Carolina, asking their opinion as to the feasibility of organizing a Southern Gas Association. Replies indicated almost universal approval. It was further requested that the representatives of the Southern companies attending the meeting of the Institute should assemble after the meeting to further discuss the matter and take such steps as might then seem advisable. The decision reached was that Mr. Maxon should issue a call to the companies to meet in Atlanta to discuss the proposed organization, and to organize the Southern Gas Association, should the movement receive sufficient support. Unfortunately, Mr. Maxon has been compelled to withdraw his services, and it has been requested of me that I write to the various companies. In compliance with this request, I now ask if you will attend a meeting, to be held at 10 o'clock A.M., May 18, 1908, at the Piedmont Hotel, Atlanta, Ga. I certainly hope that this meeting will receive your support, as unquestionably a Southern Association would be of great benefit to the Southern gas men, the companies they represent, and the fraternity at large.

Yours very truly, R. C. CONGDON, Manager.

Mr. Congdon says, in forwarding the letter to us under date of the 28th ult.: "A great many replies have been received, and the general tenor thereof was that of universal approval." He and his associates hope to and believe they will succeed in organizing a Southern Gas Association, but the exact number of States to be covered cannot naturally be determined until the meeting in May. He justly remarked that gas men in the South decidedly feel the need of an Association, and there is little doubt such an organization would be of real value. Of course, it is the intention of those interested in the above named premises to co-operate with the American Gas Institute in every possible way. The scheme seems a good one to us.

CURRENT COMMENT.—

MR. F. S. NICHOLSON, who resigned the position of Superintendent of the gas and electric division of the Elmira (N. Y.) Water, Light and Railroad Company some time ago, informs us that he has engaged in the electrical engineering and contracting business on his own account, with headquarters in the premises corner of East Water and State streets, Elmira.

NEGOTIATIONS for the consolidation of the interests of the Independent Light and Power Company and of the Peoples Light Company, of Dubuque, Ia., are again underway.

THE Corn Products Company, of Davenport, Ia., has entered into a contract with the Peoples Light and Power Company under which the latter is to furnish the former with a quantity of gas each month ranging between 150,000 and 200,000 cubic feet. This gas is to be used chiefly in the Products Company's new factory in Davenport for the manufacture of tin cans. All the soldering will be done by means of gas.

THE authorities of Hudson, Wis., are debating the better policy of constructing and operating a gas plant on municipal account, or of making a contract at the town lines for a gas supply from the Stoughton Company, the Hudson people to do the distributing.

THE Lynn (Mass.) Gas and Electric Company recently arranged with Mr. C. E. Draper, the well-known cooking by gas demonstrator, for a 4 days' demonstration, the lectures being divided into 2 classes; the first, for the morning, from 9 to noon, the second in the afternoon, from 2:30 to 5 o'clock. The morning course was really a series of lessons given to individuals, the afternoon session going along on the regular public demonstrating lines. The series was concluded last week, and we hope next week to report something about the success of the affair.

A Paris Gas Testing Station.

The *Journal of Gas Lighting* reports that the Municipality of Paris has established a gas testing station in the Rue Jacquemont, on the south side of the Seine. The apartment is 21 feet long, 15 feet wide and 10 feet high, its capacity being about 3,150 cubic feet. The size of the room allows of good ventilation and the maintenance of a fairly constant temperature while a test is being carried out. The apartment has a central partition, the space on one side of which constitutes the dark room where the observer stands. The screen is contained in a tube which passes through the partition, and upon a table below is the gas meter. The temperature of this room is kept as nearly as possible at 60° F. The room on the other side of the partition contains the photometer table, upon which are placed the Bengel burner and the scale carrying the carcel standard. Above the gas lamps is a hood furnished with a conduit pipe to carry off the products of combustion, the distance of the lower edge of the hood from the top of the Bengel burner being 18 inches. In this room stands the examiner's table. The test has to be made of gas which is actually being supplied to the consumers; and to insure that only fresh gas is being dealt with, the pipe leading from the street main and the branch connecting it with the dark room have to be cleared. For this purpose the branch is provided before it enters the room with a burner consuming about 60 cubic feet of gas per hour, which is lighted several minutes before the test is made. It is considered that a photometer room arranged as described will allow of work being carried on with such exactitude as to place the results beyond dispute.

The Use of a Storeroom Account.

[Prepared for the JOURNAL, by MR. WALTON FORSTALL.]

Just as hibernating animals live each winter, off the fat accumulated during the preceding summer, so the past winter many gas companies have been restricting their use of material to the stock which they possessed when confidence, as well as days, waned in October. In many instances the discovery has been made that an unnecessarily large amount of material had been carried in the past. It is well to explain at once that manufacturing materials are not under consideration, but principally those required by the distribution and new business departments. This material consists chiefly of cast iron pipe and specials, wrought iron pipe and fittings, brass cocks of various descriptions, heating and cooking appliances and burners, gas fixtures and other lighting appliances. Before considering what means should be employed to regulate a storeroom stock, there are certain features about the storeroom from a bookkeeping standpoint that may profitably be discussed.

There are probably many gas engineers, and also accountants, who do not believe that the practice of charging material to "storeroom" when bought, and charging it out on use against the proper account, is worth the extra bookkeeping involved. They charge their cast iron as bought to (say) "main extension," crediting to this account and charging to an operating account what little cast iron material may be used on repair work. Their wrought iron pipe and other materials for service work are treated the same way, being all charged to "new services," and a credit given for material used on renewing existing services. The material for inside work is all charged to a (say) "distribution supplies" account. The above is not intended as an exact description of such a system, but merely a general outline of its features.

As a result of this method what is saved as compared with the maintenance of a storeroom account? None of the expenses incidental to the physical care of the material, or to the record of the amount on hand, but only the relatively insignificant clerical labor of charging up the material used against various accounts. It is true that the sheets containing the information for charging out the material must be made out by the employees using the material, or inspecting the finished work; but experience has shown that the amount of work accomplished is not appreciably lessened thereby.

On the other hand, what is lost by not keeping a storeroom account? First, an exact knowledge of the material cost of the various classes of work done. When material is charged out as bought, the only way to obtain some idea of the material cost of any particular job, such as (say) setting a meter or connecting a gas appliance, is to keep a record of the material actually used on several hundred jobs, and deduce therefrom an average cost. By repeating this process at intervals, a figure will be obtained for each class of work, which, multiplied by the number of jobs, will give the total material cost for this work for the period covered by the jobs used as a multiplier. Again, there are classes of work, such as main and service laying, where the material used follows, as a matter of course, from the length of main, or the length and number of services. Right here, however, it may be said that the expense of charging out service or main material is much less than for a corresponding value of material used on fitting jobs, so that while the need of a storeroom account, to distribute material costs correctly, is least in the case of main and service work, the expense entailed by charging out this material is also least.

From what has just been said it follows that, if the storeroom account only enabled the correct charging of material, this information might be sufficiently well obtained by a cheaper method. A storeroom account has, however, a second, and most valuable, advantage from the fact that it keeps on the books at all times the amount of money invested in unused material. Any undue accumulation of material swells the storeroom figure, and this accumulation cannot progress far, unless there is gross neglect on the part of the management, without being noticed and an explanation demanded. The book value of storeroom stock replaces, for the manager of a large company, the intimate acquaintance of his stock possessed by the superintendent of the small company, who is in and out of his storeroom and storeyard every day. The larger the company the harder it is for the manager or superintendent to see all his stock, the easier undue accumulation takes place, and the greater the necessity for the storeroom account. The use of the latter as a regulator of material will now be discussed.

Let us consider, as typical of a large company, that there is a general manager, a superintendent of distribution, a manager of the new business department, a general storekeeper, and several district superintendents with their storekeepers. The general manager should fix from the best information at his command, preferably by asking the opinion of subordinate officials, upon a figure beyond which the stock must not be allowed to go, until the matter is brought to his attention with a reason for the increase and his consent obtained. This figure will naturally increase with the growth of the company, and, therefore, should be expressed in terms of that growth. A very simple, and at the same time quite accurate, way is to limit the stock to a definite amount per consumer supplied, or what is generally the same thing, per meter in service. Possibly in a year, when there is a great amount of new construction, or in a company which does a large and varying business in piping houses and selling fixtures and incandescent burner supplies, it may be found advisable to consider certain classes of material, the required stocks of which depend upon the sales being made, in terms of these sales, but these will be exceptional cases. Also, as it is usually necessary to accumulate material in the spring for the summer's work, the figure settled on by the general manager should refer to the stock as carried at the year end, and more or less discretion should be allowed the storekeeper, or whoever is responsible for keeping up stock, as to the amount of the spring accumulation, it being clearly understood, however, that an explanation must be forthcoming if any errors in judgment result in an excess stock at the year end.

What the figure should be for each plant will be settled by local conditions, and be greatly affected by the nearness to sources of supply and promptness of freight delivery, and by the character of the curve representing the monthly requirements of material throughout the year. There will probably be reasons to change it from time to time, but once settled it saves the manager from the time-wasting practice of scrutinizing each requisition for material and, by thus removing one source of frequent delay in the prompt placing of orders, has a tendency to decrease the amount of stock necessary.

The superintendent of distribution, if he has the right kind of a general storekeeper, will not be justified in seeing every order for material, but should have personal knowledge of the large orders for such material, the demand for which will depend upon new construction, such as cast iron pipe and specials, and wrought iron pipe, or be affected by impending changes in the policy of the company, such as brass cocks for services or stove lines.

The manager of the new business department should decide on every order involving special lines of goods, or on large orders of ordinary lines.

The general storekeeper should keep sufficient records to know the approximate annual outgo, year by year, of each important article (or class) of material. This record is easily obtained from the balance cards, which show at all times the existing stock of each article. Knowing the yearly use, and having information from the purchasing department as to the length of time required for delivery, it is an easy matter to avoid excessive stocking up. The knowledge of the yearly use is a pre-requisite for the proper limitation of each buying order, and, to the extent that the superintendent of distribution needs it for cast iron, wrought iron and brass material, he must arrange to receive yearly data referring to such material. A little thought bestowed on the proper forms for this data will enable the yearly requirements of cast iron to be ordered at various times throughout the year with a total expenditure of less than 10 hours' time.

The general storekeeper will use his knowledge of the yearly use to prevent undue ordering because of excessive requisitions sent in by the district superintendents, who will largely depend on their district storekeepers. In order, however, to prevent a large amount of these excess requisitions, the district storekeepers are expected to consult their balance cards to learn their average use of each article.

Probably once a year, after each annual inventory, the general storekeeper should decide upon what he considers to be material which, for one reason or another, is an overstock, and take steps to get rid of it, even if at a loss. This is the principle upon which remnant sales are based, and it avoids a continual accumulation of obsolete stuff with increased storage and handling expenses. Where tools are (as they should be) charged out on issue, no tool ledger account being kept as a misleading asset, the undue accumulation of partly used tools should be prevented by inventories, and, by the practice of sending back to the storeroom, tools which may have become surplus stock in any district.

A system as above outlined renders entirely unnecessary a useless and time-consuming, though often perfunctory, initialling of material requisitions by a lot of officials, and yet it absolutely limits the ac-

cumulation of material. Such a system, coupled with proper rewards for those men who show their ability to furnish prompt service to the customer and yet maintain a low material stock, will produce results obtainable in no other way.

A Reinforced Concrete Oil Tank Building: Design, Construction and Cost.

[A paper read by MR. CHARLES F. LEONARD, of Fall River, Mass., at the Thirty-eighth Annual Meeting, New England Association of Gas Engineers.]

The erection of a 150,000 gallon oil tank, adjacent to a railroad track and in a thickly populated district, made a building around the tank necessary, both as fire protection and to act as a reservoir in case of a leak of oil. The reinforced concrete type having been determined upon, and bids invited, they were all believed to be too high, so the Company itself undertook the erection of the building. About 5 years ago the Fall River Gas Works Company erected a similar tank and used a brick building. This time some new problems came up with a concrete structure, and it was thought it might be of interest to the Association to state them briefly.

The tank is 36 feet in diameter by 20 feet 6 inches high over all, of tank steel, weighing 10 pounds per square foot. The flat roof is submerged 6 inches below the top edge. The roof is supported by 28 vertical posts of 3-inch wrought iron pipe, flanged at each end; the upper flange is bolted to the submerged roof and the lower one lag-screwed to a piece of 3-inch plank resting on the bottom. The steel angles connecting the bottom with sides and the sides with roof are 2½ by 2½ by $\frac{5}{16}$ inch. There is a 20-inch diameter manhole in the roof, and a ladder inside and outside. The vertical seams on the side are double riveted and the balance single riveted. All seams are caulked water tight.

Design.—The reinforced concrete building surrounding the tank is 42 feet inside diameter, 12 inches thick and 25 feet high above the foundation. It is surmounted by an octagonal steel roof of corrugated iron covering, with a rise of 12 feet and a small ventilator in the apex. The wall is reinforced by ½ round steel rods, 37 feet long, bent to the curvature of a center line, 10 inches from the inside face, and with laps of 33 inches. The spacing of the rods beginning at the bottom is 3½ inches and increases to 30 inches toward the top. One-half inch Ransom rods, 7 feet long, bent at right angles and spaced 18 inches, were set vertically and radially to bind the sidewalls to the foundation.

This building, making proper allowances for weight of concrete, weight of roof and wind pressures, is as perfectly stable as an ordinary structure without the reinforcing; but if the oil tank should leak it would be subjected to bursting stresses and in this emergency would become a tank. It is, therefore, amenable to the hoop tension formula.

Tests of Portland cement concrete, of ½ and 4 mixture, show a tensile strength of fully 200 pounds per square inch. It is, however, customary to ignore the tensile strength of concrete and depend entirely on the steel reinforcing to withstand the tensile strains.

The hoop tension formula is as follows:

$$f = \frac{g\,p\,d}{2\,a}$$

where g = vertical spacing of rods in inches.
p = liquid pressure in pounds per square inch on a point midway between rods.
d = diameter of building in inches.
a = net area in square inches of steel rods in a height g.
f = allowable unit stress in the rods in pounds per square inch.

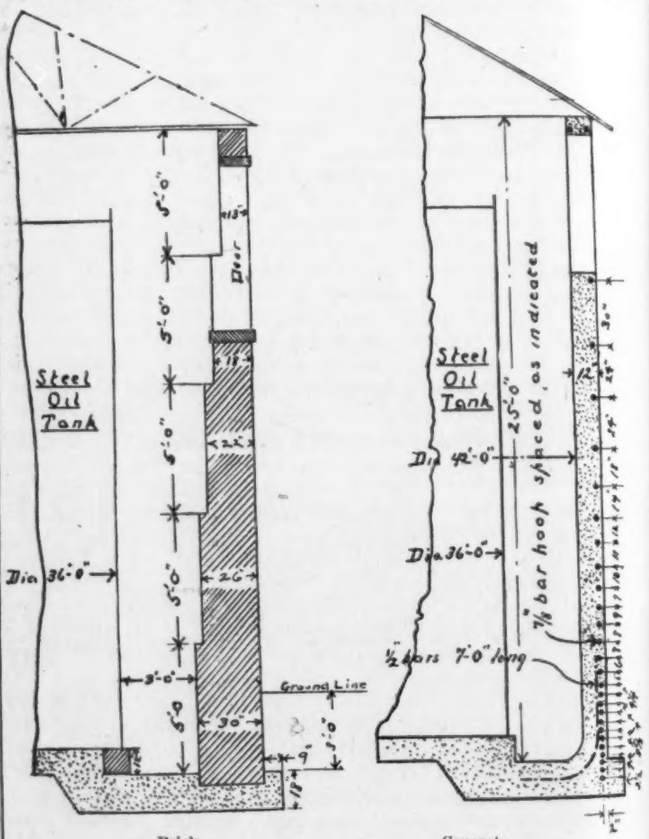
The result of a computation based on the design of this tank building, using the above formula, is given below. The spacing of the rods at the bottom of the wall is 3⅜ inches. The pressure due to 15 feet of gas oil is approximately 6½ pounds per square inch. Substituting these values in the formula,

$$f = 11{,}859 \text{ pounds.}$$

The working stress of plain steel rods is 16,000 pounds per square inch, where the elastic limit is about 33,000 pounds. Assuming that the laps in the reinforcing rods have an efficiency of 75 per cent., this gives $f = 12{,}000$ pounds required, which is substantially what the computation shows. The factor of safety is thus a trifle over two.

The reinforcing rods are placed near the outside of the wall because the concrete can be tamped much more thoroughly, and a dense mixture obtained on the inside where it is needed to prevent seepage. The bars acting as hoops, the concrete outside the bars is only necessary as protection against rust and fire. If full advantage is to be taken of whatever tensile strength the concrete possesses, the reinforcing should be placed in the center of the wall where, being evenly surrounded by concrete, the mutual support between steel and concrete in tension is more effective.

In this connection it should be noted that, although in the design shown in the cut the reinforcing is placed 2 inches from the outside



Brick. Concrete.

of the wall, the reason for its location there is not the same as the location of the reinforcing in a concrete beam. If a concrete beam 12 inches deep be taken as an illustration, its steel reinforcing, amounting to from 1½ to 2 per cent. of the volume of the concrete, would be placed about 2 inches from the bottom. The part of the concrete above the neutral axis would be in compression and the part below in tension, and the reinforcing is so placed that the concrete shifts this tension load partially or wholly to the steel. The concrete below the steel rods is of no use whatever, except as fire and rust protection. In this circular concrete building, however, the tendency of the liquid pressure would be to pull the building apart at any diameter. In other words, the two sections of the building traversed by a diameter are in tension, both concrete and steel; and the concrete is not in compression at all. In cylindrical, reinforced-concrete, grain elevators, the question of seepage not being present, where single reinforcing rods are used they are placed in the center of the wall, and where two rods are called for they are put, one near the inside and other near the outside surfaces.

The minimum thickness of the building allowable would be the least thickness that would make the concrete dense enough to withstand the pressure of the liquid. This would be determined partly by the economy in placing the concrete, as in very thin walls difficulties of placing concrete carefully around the steel might make the concrete cost more in proportion than a thicker wall. If the wall had been made thinner the area of steel would not change, but smaller sizes would be used in order to make the intervals between the bars less, thereby giving the concrete between the bars all the support possible.

The vertical steel bars, as shown in the cut at the bottom, are used to tie the bottom and sides of the building together. They are not

necessary, as far as strength of the wall is concerned. Vertical rods, 9 feet apart, were put in to support the horizontal hoops, but vertical reinforcement is not necessary in this building, because the liquid pressure is horizontal and vertical reinforcement is put in a wall to carry the load between the horizontal reinforcement and take its proportion of the vertical load.

Construction.—The wall of the building was made in movable cylindrical forms, 6 feet high and 8 feet long. The inner forms were struck to a circle of 42 feet diameter and the outer ones 44 feet diameter. The curved surfaces of the forms were made of ¾-inch spruce boards, 6 inches wide, dressed on one side and two edges, and nailed to the inside and outside chords. The chords were 2-inch planks, 12 inches wide, cut out to the proper curvature, three to each form. The inside surface of the mold was a complete cylinder. For the first three shifts the forms were supported both inside and outside by false work and braced from the ground on the outside. A ½-inch wire rope was stretched around the tank with two turnbuckles, and the forms on the inside were braced away from the tank and drawn to it with telephone wire, passing through the forms near the top and attached to the wire rope. Pieces of wood just 12 inches long were placed at frequent intervals to separate the forms from each other, but great care was taken to remove them, as well as all wire, as the concreting proceeded. To do away with a large amount of outside false work on the fourth and fifth shifts, which were just above the oil line, the forms were supported by ½-inch stiff wire rods threaded, running through near the bottom, fastened by nuts and resting on the concrete. These rods were left in the wall. The above methods of handling the mold effectually prevented bulging.

Experience indicates that a rich, dense mixture is necessary to prevent seepage. We used 1 Portland cement, 2 sand and 3½ broken stone (1 inch mesh) for the first 15 feet and ½ and 5 for the remaining 10 feet. It was hand mixed and wheeled up an incline to a plank platform, made level with the tops of the forms and running between them and the tank. The concrete was placed in 6-inch layers quite wet, so as to get it around the reinforcing thoroughly. A flat rammer was used, and also a wedge-shaped one, to force the stone back and leave a clean cement mortar face, without voids, on the surfaces. The bottom ring, 5 feet 6 inches high, was all placed in one day, but after that, in order to keep the carpenters going, the forms were shifted about one-third of the circumference at a time, and the concreting followed along after in spiral fashion. The forms were scraped and greased before being used again. When necessary to stop at a vertical joint, a 2 by 3 planed stud was placed, so as to make a tongue and groove for a bond when the ring was continued. The horizontal joints were broken the same way, care being taken to remove these wooden pieces before the concrete set hard. The sills and lintels of the 2 doors and 8 windows at the top of the building were cast in molds on the ground, and afterwards placed in position. They were reinforced the same as a concrete beam, fixed at the ends, with Ransom bars, projecting about 6 inches from the ends to tie into the wall. The wall was painted inside and outside, when finished, with two coats of neat Portland cement.

Cost.—The cost in detail of the side walls of this building was as follows:

			Per Cent. of Total.	Per Cubic Yard.
Cement..	.....$1.70 per barrel	...$348.50	16.06	$2.81
Sand.	..... 1.35 per cu. yard..	82.35	3.80	0.66
Crushed stone,	1.20 per 2,000 lbs..	176.34	8.12	1.42
Common labor,	1.75 per 9 hours....	527.53	24.30	4.25
Steel reinforcing	.....	203.93	9.40	1.65
Lumber, nails, etc	.....	181.43	8.37	1.46
Carpenters' labor.	.....	649.86	29.95	5.25
Total	.....	$1,169.94	100.00	$17.50

The cost of the carpenters' labor was fully twice what it should have been, owing to local labor conditions. The net amount of concrete in the side walls is about 124 cubic yards, making the entire cost about $17.50 per cubic yard. The bids varied from $2,450 to $4,000. The cost of laying the first ring of concrete, 12 inches thick and 5½ feet high, ¾ and 3½ mixture, was as follows:

Material	.....$4.55	per cubic yard.
Labor	..... 1.36	" "
Total	.. ..$5.91	" "

Brick Tank Building.—In 1902 there was erected right beside this concrete building a brick building to inclose a tank of identical dimensions. The cut shows this building in cross section. As it is not safe to depend on the tensile strength of brick laid even in Portland cement, 1 to 3, this building is computed for strength the same as a dam.

A section, 1 foot wide and of full thickness of this building under the door, contains 40.4 cubic feet, which, at 112 pounds per cubic foot of brickwork, gives a weight of 4,524 pounds. The center of gravity of the wall is 12¾ inches from the outside edge, which gives a moment against tipping of 4,800 foot pounds. If filled with liquid to a height of 15 feet, the center of pressure would be 5 feet from the bottom. The total pressure acting at this point per square foot would be the weight of a volume of liquid, 1 foot square and 7½ feet high, or 469 pounds multiplied by 5 feet = 2,345 foot pounds, the moment tending to overturn the wall; 4,800 ÷ 2,345 = 2 + as factor of safety, ignoring entirely the tensile strength, which really ought to add considerable. This building would require 141,000 bricks, which, at $20 per 1,000 laid, the rate quoted at the time of erection of the concrete building, would give a cost of $2,820.

The net saving, therefore, in this particular instance, of a reinforced concrete oil tank building over a brick one for the same purpose was $650. The concrete building cost about 77 per cent. of one built of brick. It is more than probable that, if conditions had been favorable, fully $300 could have been saved in the carpenters' labor, making a net saving of $950, and making the net cost of the concrete building about 67 per cent. of the cost of a brick one.

Address of the President (Mr. J. H. Eustace, of Chicago) of the Illinois Gas Association, on the Occasion of its Fourth Annual Meeting, Chicago, March 25 and 26.

Members of the Illinois Gas Association: No matter how much experience a man may have along the special lines which have kept him busy, it is a little hard for us, who have spent our time in the technical or operating ends, to address our friends in the industry as a whole. You represent every line of thought which is applied to the entire subject of the manufacture and sale of almost every kind of industrial gas, and each of you is able to do good work in his particular line.

The real benefit which is derived from associations such as this comes from the work of the committees that take up special subjects, and from the work of the good men selected to present papers dealing with matters with which they are especially familiar.

The President in his address will do well, therefore, merely to open the way for the presentation of these papers, urge earnest consideration of the reports of such committees as may be appointed from time to time and recommend a full discussion of papers presented.

While we are here as individuals, the interests of the gas companies with whom we are connected are vital to us, and these interests, taken in their largest sense, are vital to the public whom we serve. When I say that these interests should be protected, and that we should do our part in protecting them, I do not mean to be taken as suggesting any petty, narrow or selfish defence.

The best interests of the gas companies are best served when those who direct the gas companies fully realize that these companies are in business in precisely the same manner as the merchant. They must manufacture and sell a good article. They must give the public as much light, heat and power for the money as possible. No intelligent gas appliance salesman to-day would offer an appliance for any of these purposes, and recommend, as one of its advantages, that it would burn more than the absolutely necessary amount of gas. Appliances which will give the public the most and best service, in either light, heat or power, for the smallest amount of gas, and consequently the least money, are those which it is to the best business interest of the gas man to recommend and to install.

The old "take it-or-leave-it" idea that a gas company had a monopoly, and that the people must buy its gas, is now happily abandoned. We have competition, and severe competition, and it is only by careful attention to every detail that we are able to extend the use of gas and to hold the ground gained.

A gas association differs from most commercial bodies in the fact that we are practically alone among industrial associations in not being in competition. When merchants or other manufacturers get together, they are often men who have for years been fighting each other, whose travelling men and agents are struggling with each other for business, and whose commercial warfare has often brought

bitterness and the different members, while seemingly cordial, are for the time being merely in a state of "armed neutrality." The meeting together of a commercial association of the character of this one finds its greatest mutual benefit in the fact that friendships are built up, mutual respect and regard established, and a better feeling in that trade or business is developed.

In our Association we do not have the bitterness of trade rivalry. There are no old memories to be overcome and no quarrels to be patched up. It is, therefore, very gratifying that we can start with the foundation of good fellowship and friendship, and devote our time chiefly to a concerted endeavor to advance the industry we represent in every possible way.

There are some things which have not yet been developed by invention which we need. In the three great branches of our industry—light, heat and power—we are equipped with different degrees of completeness. For heat, the stove and burner men have arrived at a very satisfactory stage of development; but it is not so entirely true of the other branches.

For instance, we need a low candle power, high efficiency, incandescent burner. At the present time there are a large number of different styles of incandescent burners which will give reasonably high efficiency for the gas consumed, provided a fairly large amount of gas is burned giving a large "observed candle power."

Any good mantle burner will give 60 candles for 3 feet, or an efficiency of 20 candles to the cubic foot; but it is necessary to have 3 feet and get 60-candle power to obtain the 20-candle power per foot efficiency. It is not possible for us to supply the trade with a burner consuming 1 cubic foot and giving 20 candles. If a man wants only a 20-candle power light, and is satisfied with that, he must burn his gas in an open flame with an efficiency of 4 candles, instead of 20, to the foot.

We can tell him to substitute an incandescent burner for his open flame and he will get 30 candles to the foot instead of 4, but he must burn 3 feet and have 60-candle power to effect this economy. If his reply is that a 20-candle power light is ample and all that he wants, we have nothing to offer him except the low efficiency open flame.

In the other branch of our industry—power - there is a great demand for an efficient, self-contained, noiseless, low speed, well-balanced gas engine, built in small units, say from ½ to 10-horse power, which might be substituted for a large number of electric motors now in use. There are, to be sure, some small gas engines, but they are, for the most part, poorly made, inefficient, very noisy, and, by the single acting, 2-cycle operation, so unbalanced that they impart a vibration to everything around them. In addition, they require connection to a water supply system which prevents their being self-contained. A small, efficient, noiseless, well-balanced, easily started, low-speed gas engine with its own water system, something on the line of the cooling system on an automobile, would open large possibilities for increased consumption to the gas business.

There are many other suggestions in both the manufacturing and commercial ends of the business which will occur to you, but I will not take your time to enumerate them, except cursorily to refer to what I conceive to be the very keystone of successful management.

We are all, I think, a little wiser in our generation, and to-day, than we were in the past generation, and yesterday. The public service corporations to-day have, possibly, a greater duty than ever before to perform, and have learned or must realize that the more efficiently, the more thoroughly and, let me add, the more courteously, they perform this service, the more profitable it is for them. The public is learning what a tremendous advantage it is to always have available in proper pressure a constant supply of gas which will light the home, warm the house or furnish power for all purposes; an article which can be used as wanted, which is not wasted, which is accurately measured, and for which the charge is so low that it is cheaper for these purposes than any other means now available.

In the development of this proposition it is imperative that intelligent men deal with the public, men who realize that, in courteous dealings, in pleasant helpfulness, in bettering the means of illumination, in aiding the consumer to make the stove or engine work right, or the mantle to give light, and in a hundred other helpful and considerate things, lies his success as well as that of the company which he represents.

Neglect or disregard of this fundamental principle, to my mind, will inevitably have a tendency to suggest to the people or the State, to endeavor to take into its own hands the control and management of our business. I need not, I am sure, refer to the feeling of distrust and suspicion that has been engendered against corporate management. That there is substantial ground for this public feeling, no sensible man will gainsay, but the unfortunate feature of this feeling is its indiscriminate character. Practically all public service corporations are under suspicion. The public mind is being systematically worked up to a pitch dangerously approaching public frenzy, and we may reach a stage where calm, dispassionate reason is displaced, and unreasoning demands be insisted upon, the inspiration of which is a desire to punish someone, if indeed it does not partake of a spirit of revenge.

There seems to be a prevalent notion that relief is to be found in public commissions, and commissions are the current panacea for all sorts of evils from which the body politic thinks it is suffering. There are plenty who foster and encourage this idea, and, if the sober sense of our people is not called into action, it may mean that the property of public service corporations will in effect be taken out of their hands and the management thereof placed in the hands of men with no fitness whatever for the offices they assume, based upon previous experience or knowledge of the peculiar features of our industry. Should such a situation be developod the ultimate result is not difficult to perceive, nor far distant in its application. It is impossible that men thus placed in control and management of public corporations, with no previous training in the industry, can as efficiently, as can the men who have devoted their lived and their fortunes to it, manage such a business, either from the standpoint of the corporation, that is necessarily most vitally affected, or the standpoint of the public.

I need not say that I do not object to reasonable supervision by the State of business affected with a public character. No sensible man does. I am only endeavoring to point out that, at this time, when the public mind has been skillfully led to believe that all corporate management is a public menace, we should stand up and assert the contrary, for I know, and you know, and the best blood of the American people knows, that, generally speaking, corporate management is honest. I cannot, however, close my eyes to what is occurring, and, therefore, I fear that the present public feeling may, if unchecked, and reason is not again called into her just dominion and sway, reach a point where the public will pass laws without regard to private rights, causing private wrongs of a grievous character. As ex-President Cleveland so aptly said a few days ago:

"Of course, there is always need of reform * * *; but there should at the same time be kept steadily in sight the protection of that personal or private liberty of action which lies at the foundation of our institutions."

The best possible preventative of any such condition as I have suggested may arise, is to give to the public the highest possible efficiency of service, at the lowest possible price consistent with good business management, and a due regard for the growth and extension of the business which necessarily affects the public more than anyone else, together with a ceaseless solicitude for public susceptibilities as well as public rights, so as to disarm, so far as possible, that suspicion that unfortunately exists, and that seems to be so general and indiscriminate in its application. As the public grows to realize the mutuality of the public interest and the private interest, all bitterness should disappear from criticism, and a spirit of goodwill rather than one of antagonism ensue. I am certain that we can best protect the interests of the companies we represent by the most generous consideration of the public.

The Illinois Gas Association was originally organized for the purpose of mutual protection of the interests of its members. The membership consisted then of gas companies of the State of Illinois. At the meeting in 1907 the by-laws of the Association were changed so that membership now consists of individual members. The original purpose of this Association should, in my judgment, not be lost sight of, and a desire to mutually keep and conserve those interests should be the guiding inspiration; the injury to one should be the concern of all. It is in this aspect that I have ventured to make the suggestions herein contained.

I am indebted to this Association for a great honor which I deeply appreciate. By a change in the by-laws (altering the date of the meeting) it has been my good fortune and privilege to preside twice over the annual meeting of this Association. I wish especially to thank the members of the various committees and those who have aided me for their persistent helpfulness. I also wish to thank the members who have so ably contributed to the success of our meeting by preparing papers on various and important subjects, and all those who have so kindly assisted in Association work.

Retort House Practice.

[A paper read by MR. W. E. HARTMAN, of Aurora, Ills., at the Fourth Annual Meeting, Illinois Gas Association.]

Retort house practice of to-day is distinctly different from that of 25 years ago, and probably just as widely different from that of 25 years hence. A quarter of a century ago small, direct-fire settings of 3 to 6 retorts, run at relatively low carbonizing temperatures, were in general use. The temperatures being low, there were no such difficulties as we have to contend with to-day, viz.: The production of lampblack and naphthaline. Fuel results were not a point to be considered because the market for coke had not been developed. So, at that time, there was no demand for the saving in bench fuel which has now been accomplished by the adoption of recuperative benches. Looking ahead a quarter of a century it is no idle dream to foresee a marked and radical change in retort house methods.

Retort house practice is passing through a transition period. The foremost engineers have come to a realization of the weakness of our carbonizing methods from a scientific standpoint. Studying the thermo-chemical reactions in a retort, they appreciate the crudeness of a process which involves the destruction of some of the most valuable constituents of the principal product with the resultant formation of such undesirable and troublesome substances as lampblack and naphthaline. They realize the need of improvement and will welcome a more scientific method of carbonization. The vertical retort appears to solve the problem by offering a carbonizing vessel in which the gas as evolved is not destructively overheated; consequently retaining the hydrocarbons, which in the horizontal retort, are partially decomposed to form lampblack and naphthaline.

The progress made in the development of vertical retort construction is certainly gratifying. We read of the Woodall-Duckham vertical retorts which are operated continuously, being automatically charged and discharged. Let us imagine, if we can, a retort house, without any of the smoke or dirt with which we are now familiar in that part of our plant; and besides that, the production of better gas, better tar, 50 per cent. more ammonia, and no lampblack or naphthaline. From our present view point such a picture certainly partakes of the ideal in retort house practice.

But we are now concerned with the present retort house practice, and that in Illinois more particularly. With this in view we will restrict the subject to a treatment of hand operated, horizontal retort settings, and, more especially, recuperative settings.

Foundations.—Our bench foundations must be of the best. In some cases this is a simple matter, but in others the conditions may warrant extreme measures, such as driving piles; but however difficult this phase of the construction work, it should not be neglected. If the foundation is unstable, cracks will result in arches and in flues, with detriment to bench results.

Style and Size of Setting.—It has been clearly demonstrated that recuperation pays, and pays in proportion to the amount of recuperation; in other words, that the fuel economy accomplished by recuperation more than offsets the difference in first cost between direct fire settings and gaseous fire settings.

Special local conditions in retort houses have been the cause for the installation of half-depth benches with pits in front. Their operation has proven them to be not altogether desirable. As a full-depth setting for hand operation a setting of 9 retorts offers many advantages over a setting of six. The larger setting economizes floor space, operation labor and furnace fuel. A full-depth bench of sixes will require from 2 to 3 pounds more fuel per 100 pounds of coal carbonized than a full-depth bench of nines. The middle bottom retort in a setting of nines has been of short life in some styles of settings. But the writer has experienced no such difficulty, and has had settings of nines in continuous operation for over 48 months up to date, each retort generating 11,000 cubic feet of gas per day.

Size of Retorts.—Progress with vertical retorts has shown that space above the charge in a horizontal retort is not needed either for the passage of the gas or for the swelling of the charge during the coking process. It has been found that a retort may be charged full of coal without any injurious swelling of the charge, the gas travelling out through the center. With this in mind, we realize that the only reason for space above a charge in a horizontal, hand-operated retort, is the need of rake room in drawing, and this space should be no larger than is necessary for this purpose. It is this open space that is at the root of our carbonization evils, this space through which the gas travels exposad to the heat of the bare top and sidewalls of the retort. *I*t is here that our valuable illuminating hydrocarbons are decomposed into hydrogen and free carbon, this free carbon manifesting itself in standpipe and hydraulic main stoppages, and in the production of a poor grade of tar. Here also naphthaline is formed as a decomposition product of benzine. So it behooves us to avoid as much of this open space as possible. If conditions demand small charges the retorts should be correspondingly small, so that the charges will nearly fill the retorts, leaving only room for the rake. It is manifestly poor practice to charge small charges in large retorts. The writer has found it advisable to charge from 380 to 400 pounds, the retort measuring 16 inches by 28 inches by 9 feet. In a recuperative setting, particularly a full-depth setting, this size of charge can be carbonized in 4 hours, yielding 5 cubic feet per pound from Pittsburgh coal, without any danger of running too close to the refractory limit of good bench material.

Bench Material.—Bench material is not all alike in quality. Retorts and brick of one make may differ widely in durability from those of another make. There may be a difference in refractory qualities and in heat conductivity. Again, some grades of brick may lack uniformity of size and shape, so that it is impossible to lay them without some of the fireclay joints being too thick for good firebrick mason work.

Bench Ironwork.—The proper location of the charging door of the furnace is important. The door should be so placed that hot coke may be dumped into the fire without shovelling, and so that a full, level fire can be maintained without it being necessary to push back the bulk of the fuel. As it is advisable to have the firing door open as short a time as possible, we certainly should not be obliged to shovel the fuel in and then laboriously push it back in the furnace. Standpipes should be at least 7 inches in diameter. A diameter of 8 inches is preferable. Steel pipes have been substituted for cast iron to some extent and have proven satisfactory because of their lightness and durability.

Hydraulic Main; Dip Pipe Seal and Tar and Liquor Off-Takes.—The hydraulic main should be easily accessible for cleaning, and should be fitted with a proper tar and a liquor off-take. The usual arrangement bolted onto the end of a hydraulic, and designated as an automatic adjustable tar and liquor off-take, has no excuse for existence in a retort house. I refer to the common arrangement in which the tar and liquor are supposed to pass out through an opening at the bottom of a partition and then pass off through an overflow, this point of overflow being adjustable. The tar and the liquor should have separate outlets from the main and any attempt to pass them out regularly and together in the above manner will result in irregularity of the seal on the dip pipes. The difference in specific gravity between the tar and liquor is so great that they will not run away together under these conditions. Regularity of dip pipe seal is vital to successful operation. The seal should be deep enough to avoid drawing air when mouthpieces are open. Only $\frac{1}{16}$ of an inch would accomplish this purpose if the water in our hydraulic main were quiet and suffered no fluctuation due to the bubbling of the gas out of the dip pipes; and if our exhausters were so nicely governed that there could be no variations in the vacuum. To be safe, it is necessary to carry a heavier seal, say $\frac{1}{2}$ inch to 1 inch. But the seal should be no deeper than is necessary for safety. If the seal is excessive, this excessive pressure in the retorts has a deleterious effect upon the hydrocarbon in the gas, more lampblack is formed and more stopped standpipe troubles are experienced, and the same condition is favorable to naphthaline formation.

Now, if the hydraulic is equipped with an off-take which insures an irregularity of seal, the variations running as high as 1 to $1\frac{1}{2}$ inches, it is evident that, in order to avoid drawing air, our average seal during these variations must be much deeper than if we have a proper off-take. In this connection the writer has had very satisfactory experience for the last 3 years with a tar displacement arrangement. The hydraulic main is fitted with an adjustable liquor surface overflow. In addition the main has at the bottom a 6-inch connection to a tank at a lower level. At the start this tank is full of water or ammonia liquor. A valve is opened on the 6-inch connecting pipe, and the tar, as deposited in the main, slowly flows down into the tank, the water in the tank being displaced and flowing up through the same 6-inch pipe into the main. Periodically this tank is shut off and the tar run out through a connection to the tar well, after which it is filled with water and put in action again by opening the the 6-inch valve. Instead of using fresh water to fill the tank each time, the liquor overflow from the hydraulic main may be used. In this case it is necessary to install a liquor tank at a higher level than the tar displacement tank, to receive the hydraulic main overflow.

By the use of this arrangement a hydraulic main serving 75 retorts, which has been under the writer's care, has been kept practically free from tar accumulations, it being necessary in addition to clean out through cleaning pockets not oftener than once in 4 months, obtaining not over 1 barrel of heavy tar lumps from the whole main.

Unloading and Storing Material.—When material is received, the gas company usually unloads and stores until the arrival of the erecting company's mason. In unloading retorts and material, due care should be exercised to avoid breakage and chipping off of corners; as carefulness at this time is well repaid in the useful life of the material. The material should be stored under cover in a dry place.

Mason Work.—In the mason work of erection, the use of excessively large fireclay joints should be avoided. Firebrick should be bedded almost brick-to-brick. If arch blocks do not fit, loose spacing pieces to fill out should not be used. Such filling is not conducive to strength. The mason should leave plenty of stoppers in the front wall of the bench between and around the retorts to facilitate inspection and cleaning.

Erecting Ironwork.—When attaching mouthpieces, the nuts should be drawn up on the bolts only with the fingers. If these are tightened with a wrench, there is danger of breaking the retort. Usually a rust joint cement is used on mouthpiece flanges.

The following mixture makes a good cement: One part by weight fine cast iron borings; three parts by weight fireclay. Mix with strong ammonia liquor or with a saturated solution of sal ammoniac in water.

In erecting standpipes, the spigots should be centered in the bells, allowing at least ¼ an inch space in one of the bells of each standpipe, from the end of the spigot to the bottom of the bell. If these joints are made up iron-to-iron, the expansion of the pipes when heated up may be sufficient to break the mouthpiece off the retort. It is not advisable to use rust joint cement in standpipe joints, as it is difficult to remove when taking down pipes to renew retorts. The writer has found that slacked lime makes a tight joint and is easily removed when necessary. It is advisable to leave one joint on each standpipe to be made up after the setting and ironwork have been heated up, or just before the retorts are in charging condition.

When a bench is shut down for any reason, the standpipes should be shut off from the hydraulic main. If the pipes are down for resetting a bench, blind flanges may be bolted onto the bridge pipe flanges; these blind flanges to be kept on hand for this purpose. When erecting the pipes a blind gasket of heavy asbestos paper may be inserted between the standpipe and the bridge pipe flanges. After the drying out and heating up of the setting, or just before charging the retorts, these blind gaskets can be cut out on the inside of the pipe by reaching down through the bridge pipe openings. An important detail of ironwork erection is the leveling of the hydraulic main to insure equality of seals on all dip pipes.

Drying Out; Two Weeks.—The moisture occluded in the pores of retorts and firebricks must be driven out gradually to avoid damage to the material. If a setting, made up of damp, moisture-laden material, is brought up to a high temperature suddenly, the formation of steam in the pores of the material will be so rapid that it cannot escape without working injury. Therefore, it is highly important that care be given to the drying-out period. Before starting the fire, there should be water in the ashpan, all dampers and air slides should be tightly closed, the clinkering door wide open, and all stoppers out on the face of the bench between and around the retorts. A coke fire should be carried about 12 inches deep throughout the length of the grates. The clinker door being wide open, a large volume of slightly warmed air arises slowly through the furnace, around the lower retorts, and out through the lower stopper holes, at the face of the bench. If this warm air were led out through the waste gas flues and the stack, the moisture picked up from the furnace walls and setting would be deposited by condensation in the cold flues.

This low fire should be uniformly maintained for 2 weeks. It is advisable always to feed hot coke into the fire, or if cold coke must be used, the fire should never be entirely covered with cold fuel. This precaution should be observed until the bench is under full fire and the setting itself is hot enough to ignite the mixture of carbon monoxide and air above the fuel. Neglect of this precaution may cause damage to the setting by explosion. After 3 days the lower stoppers may be inserted, thus causing the warm air to travel higher in the setting to escape through the upper stopper holes. After 1 week the remaining stopper holes may be closed and the stack dampers opened slightly, so that the warm air will be drawn through the flues and up the stack, drying out the recuperators.

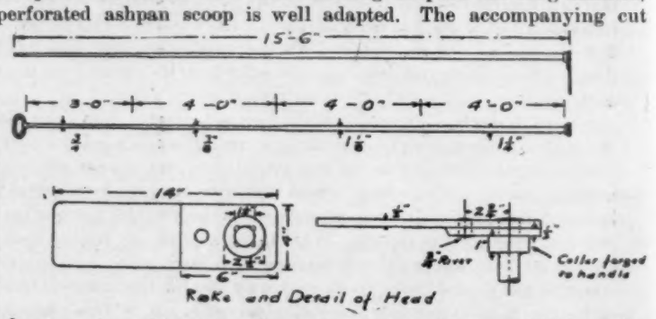
Heating Up; One Week.—At the end of 2 weeks the moisture should have been thoroughly driven out, and the bench may be brought up to a working heat by gradually increasing the amount of fire, keeping the clinker door ajar now, and also supplying air through the primary air slides, which are opened only slightly. After 3 or 4 days of this heating up period the clinkering door may be closed and the primary air ports and dampers opened wider. When the combustion chamber shows a good red heat, secondary air may be admitted, and the bench brought up to working temperature as soon as possible, charging the retorts when they reach a good red heat.

Shutting Down.—To let down a setting, all openings should be closed and the bench thoroughly sealed up with clay at all crevices around doors or stoppers. The dampers should be left only slightly open. Closing up the bench in this way will insure gradual cooling without injury from a too rapid contraction of the material. After the gas has been driven out of the charges left in the retorts, the standpipes should be closed off from the hydraulic main. It is sometimes necessary to close down a bench for only a few days at a time to take care of sendout variations. At such times it is advisable to keep the retorts hot without allowing the bench to become overheated. This requires careful adjustment of the air slides and dampers. In some cases the proper heat may be held in the bench by simply checking the stack dampers sufficiently. During such times the furnace should be fed with fuel and the fire clinkered as usual.

Adjustment of Air Slides and Dampers.—The primary air slides are the openings through which the fire receives all of the air for the combustion of the solid fuel and the production of producer gas. The retorts are heated by the burning of this producer gas as it unites with secondary air introduced above the furnace arch of the producer. To increase the heat on a setting we introduce more primary air, thus burning more fuel and generating more producer gas. And in order to burn this increased amount of producer gas it is necessary to correspondingly increase the supply of secondary air. Now the combustible constituent of the producer gas is carbon monoxide, which burns with a blue flame. We may take advantage of this fact in adjusting our secondary air openings. If there is not enough secondary air entering the combustion chamber to burn up all of the producer gas, we will find this carbon monoxide in the waste gas flues, and on opening a stopper sight hole it may be seen burning with its characteristic blue flame.

The stack damper should be opened only enough to pull in the right amount of primary and secondary air. If possible, and still retain the proper heat on the setting, the dampers should be checked so that there is back pressure shown at the middle sight hole. Such checking will result in decided fuel economy. If too much draft is carried, the hot products of combustion are carried out of the setting to heat the stack and the surrounding atmosphere. After air slides and dampers have been once properly adjusted, it should not be necessary to frequently alter them if the operating conditions are unchanged. No change being made in the grade of coal charged or the size of charges nor in the kind of furnace fuel used, any sudden change in the heats is usually caused by an improperly clinkered fire, an accumulation of dust in the flues, or of patching material on the furnace arch stopping up the producer gas nostrils. Irregularities in heats should be investigated before readjustment of air slides and dampers, It is sometimes found that one end of the bench runs considerably hotter than the other end. This may be remedied by closing up one or more of the furnace arch openings at the hot end by means of a tile inserted through a stopper hole.

Tools.—For hand charging, the writer has found No. 6 charging scoops a convenient size. For cleaning ashpans the long-handled, perforated ashpan scoop is well adapted. The accompanying cut



Rake and Detail of Head

shows a rake which is easily made and requires very little repairs. To clean standpipes it is necessary to have a supply of reamers. The augur-shaped reamer, with a flexible spring steel handle, is probably

the best. For each bench there should be a set of supplementary clinkering bars. These are preferably flat, 1 inch thick by 3 inches wide, pointed at the end. In addition to these, there are needed clinkering bars of 2-inch iron, pointed with steel, and sledges for driving same, and hooks for pulling out clinkers.

The charging wagons and coke barrows should be as large as the local conditions will permit, in order to save labor.

Firing the Furnace.—The use of coal as bench fuel was very ably treated, in a paper by Mr. W. R. Rhoades, of Springfield, read at our last meeting. If coke is used as fuel there is a decided advantage in feeding it hot as drawn from the retort. By so doing we not only economize on fuel but also prolong the life of our bench, as we avoid the chilling effect of cold fuel. The furnace should be fired at least every 2 hours, thus insuring the advantages of a deep fire. And the fire should be pushed back to keep the fire bed level. This will avoid short circuiting of air and irregular heating of the different parts of the setting.

Water or steam is used in the ashpans to keep the temperature of the ash of the fuel below the fusing or clinkering point. This temperature varies for different fuels, depending on the varying proportions of fusible constituents in the ash. The writer favors the use of water over that of steam, as the quantity can be more easily regulated. The supply of water should be visible without opening the clinker door. A constant stream is supplied to the drip-plates and thence to the ashpan, where it is evaporated. The resultant steam keeps the ashes cool and is then decomposed into hydrogen and oxygen by the hot coke, from which heat is absorbed in the process. In the combustion chamber this hydrogen unites with oxygen and burns to form water vapor again, giving out an amount of heat equal to that absorbed in the decomposition of the water vapor down in the fire. However, the use of water or steam is not unattended with an ultimate loss of heat, such loss being explained by the difference between the temperature of the water or steam admitted in the ashpan and that of the escaping stack gases. For this reason an excess of steam is to be avoided.

Cleaning Fires.—With a coke fire, using coke from Pennsylvania coal, the clinkers should be thoroughly removed with the aid of supplementary bars every 3 or 4 days. With a coal fire, using the same coal, once a week is sufficient. Just before cleaning the fire the firebox should be filled and the clinkering should be done entirely through the clinkering door. A deep fire is particularly desirable at this time to avoid excessive cooling of the setting by the entrance of a large volume of cold air through the open clinker door.

The supplementary bars are driven in close together above the top water plate until their ends rest upon the brick ledge at the back of the firebox. They serve to hold up the coke above this point, permitting the thorough cleaning out of the clinkers and ashes below, after which the bars are withdrawn. The cleaning is facilitated by the temporary removal of the grate bars. As the work should be done as quickly as possible, it is advisable to arrange to have 2 men work together on each fire. In addition to this thorough cleaning out of all clinkers and ashes, the fire should receive further attention every 6 hours. At these times through the clinkering door a light bar should be driven through the fire and along the furnace walls, loosening up any clinker formation and incidentally forcing ashes down into the ashpan. The ashpan should be kept clean to facilitate the evaporation of water. By the foregoing method of furnace treatment, at the end of 4 years' operation the furnace linings of benches under the writer's observation have been found eaten back a distance of only ¼ a brick or 4½ inches.

Charging Retorts.—A fixed size of charge should be adopted to conform to the size of the retorts, and this size of charge should be adhered to, the heat on the setting being maintained by proper attention to the furnace and flues. All of the coal should be weighed on a scales whose accuracy is frequently tested. It is advisable to paint on the charging wagons the desired gross weight of the load, thus facilitating accurate fillings. The chargers should be taught to lay an even charge, keeping the coal back of the iron mouthpiece.

Quenching Coke.—If the coke is quenched by means of a spray or hose, a large excess of water should be guarded against. Water soaked coke is not easily marketable. For this reason the writer favors the use of buckets, unless spraying can be done by some method that restricts the quantity of water to the amount needed.

Decarbonizing.—At regular intervals, of from 8 to 10 weeks, each retort should be decarbonized. This is done by burning loose the deposits of hard carbon which have accumulated by the decomposition of the hydrocarbons in the gas and tar. There are various methods of decarbonizing. The old way was that of laying a line of half-round tile along the bottom of the retort and bricking up the rest of the mouthpiece opening allowing natural draft to circulate through the tile and return through the retort and up the standpipe. This method is slow, and often allows the retort to become dangerously hot. It has been superseded by more rapid methods, most of which work less injury to the retorts. The use of compressed air gives very good results. A common method is that of using a steam jet blowing into the open end of a 5-inch or 6-inch steel pipe laid in the retort. This forced draft facilitates the process. This method has been improved by the addition of a small pipe coil lying in the retort through which the steam first passes and is superheated, thus insuring the use of dry steam, as well as economizing on its quantity. By these methods 4 hours should suffice for decarbonizing a retort, if it is comparatively new. If holes develop during the process, the burning of the carbon will be delayed, and it is advisable to patch such holes at once before proceeding with the decarbonizing. When the carbon is sufficiently loosened up, so that it may be removed easily, the retort is ready for patching. It is not advisable to facilitate decarbonizing by vigorous use of a bar, the burning out in such cases not having been sufficiently prolonged.

Patching Retorts.—A retort as installed is in one piece, but through unavoidable conditions of operating it undergoes sudden contractions by cooling, as when charged, and soon cracks appear. These cracks become filled with carbon, which binds the retort together and prevents leakage. But occasionally we find holes caused by pieces of retort falling out. These are more especially in evidence after decarbonizing, as the decarbonizing process burns out the carbon in the cracks. To properly patch these holes without letting down the bench often calls for considerable skill. A hole may be covered with a tile and fireclay plastered around it; but such is not good practice, as it leaves an objectionable obstruction in the retort. A better plan is to fill the hole with a good grade of retort cement and make the patch conform to the regular shape and size of the inside of the retort. To do this it is often necessary to insert, through a stopper hole in the face of the bench, a large, flat iron bar so bent that a flat surface can be held against the outside of the retort over the hole. Then, from the inside of the retort, using a paddle, the hole can be filled with cement, backing up with the bar on the outside. The cement sets at once and the bar is withdrawn. A large hole in the top may be patched from the outside of the retort, backing up with a bar on the inside. If there is no convenient stopper hole, it is sometimes necessary to make an opening for the purpose. Holes of any size may be smoothly patched by this method. The writer recalls an experience with one measuring 18 inches by 24 inches, running up the side, and part way across the top of the retort. A piece of heavy sheet iron, bent to conform to the inside of the retort, was used as a form on which the retort cement was plastered, working through an opening in the wall outside of the retort until the hole was filled. The sheet iron was withdrawn after the cement had had sufficient time to set.

After patching a retort the furnace arch should be examined for pieces of retort or patching material. If this has been neglected, it is sometimes necessary to use a bar and sledge to loosen up such material. It is important that the furnace arch nostrils and secondary air openings be kept clear.

If after decarbonizing the retort is charged with coal, a large part of the gas from this first charge will be lost through the innumerable small cracks. Consequently the writer favors the practice of first charging a mixture of coal tar and coke breeze, in order to carbon up the cracks and prevent leakage in the subsequent coal charges.

Cleaning Standpipes.—No other work is more disagreeable and exhausting than that of punching stopped standpipes, and the necessity for such work should be minimized. If the carbonizing conditions are favorable for the production of lampblack, if for any reason the gas does not quickly leave the retort and suffers undue exposure to the hot retort walls, standpipe trouble may be expected. If the gas must travel the length of a long, through, horizontal retort or a long inclined retort, or if the charge is too small for the retort of shorter length, or if the dip pipe seal is heavy and irregular, the gas will be overheated in the retort, and an excessive amount of the hydrocarbons will be decomposed into carbon and simpler hydrocarbons or hydrogen. This free carbon in the form of lampblack adheres to the tar coated standpipe, and accumulates along with more tar, gradually closing up the pipe. In the meantime, the tar in this mixture, by exposure to the hot gas passing through the pipe, has its light oils distilled off and is converted into a hard and tough pitch, a substance sometimes very difficult to remove.

Large standpipes are a partial remedy, as they act as better condensers for the lighter tar, thus keeping the inside of the pipe washed down, as it were, with tar. Steel pipes are more efficient in this particular than heavy cast iron pipes. Palliative remedies for stopped pipes have been used with more or less success. A small stream of water running down the inside of the pipe will better condense tar and help to keep pipes clear. The writer visited one plant where it was the practice to place in the iron mouthpiece, just before closing up, a large lump of cannel coal. The light tar from this coal helped keep the standpipes clear. Gas works mechanics have taxed their ingenuity in the construction of efficient pipe reamers, to cut out this hard deposit.

But it seems that we are shooting wide of the mark when we neglect the primary cause of stopped standpipe trouble. If our carbonizing conditions are such that an excessive and troublesome amount of lampblack is formed, it is the part of wisdom to improve those incorrect operating conditions. In one plant with which the writer was connected, where long, through retorts were in use, lampblack trouble was overcome by bricking up a wall in each retort, making them one-half as long.[1] In another case the remedy was found in increasing the size of the charge, correspondingly increasing the heat on the setting. Again, a deep and irregular seal on dip pipes has been decidedly improved by the installation of a separate tar and liquor outlet on the hydraulic main.

Cleaning Hydraulic Main.—Hydraulic main stoppages are usually concurrent with standpipe stoppages and have the same origin. Lampblack deposits itself in the hydraulic with the tar, forming a substance too thick and viscous to flow away. Various expedients have been adopted to handle this. By the use of steam jets along the bottom of the main the fluidity of this heavy tar and lampblack mixture may sometimes be increased.

Also, by pumping a stream of ammonia liquor continuously through the main, circulation may be increased, and thus a part of the lampblack be discharged before it has time to settle down and mix the tar; but the writer has seen carbonizing conditions so bad that these remedies failed to overcome the difficulties, and it was necessary to employ men continuously cleaning out the hydraulic through the cleaning pockets provided for that purpose. To arrive at the proper solution of these difficulties, we must realize the cause of any excessive lampblack production and change any incorrect carbonizing conditions. In other words, we must avoid excessive overheating of the gas in the retort. To be sure, this cannot be entirely avoided in a horizontal or inclined retort, however large the charge, or however short the retort, as well as in the modern vertical retort. But the nearer we approach vertical retort practice in this particular, that of the treatment of the gas in the retort, the more surely will we avoid excessive lampblack formation with its resultant standpipe and hydraulic main stoppages, as well as the excessive formation of naphthaline.

Naphthaline.—This latter substance, being formed under these same adverse conditions in the retort, also presents to us a problem in carbonization. We may devise any number of methods of condensation or of scrubbing to handle this substance after its formation; but it originates in the retort. And it is only by changing conditions in the retort itself that we may be able to prevent its formation and retain in the gas the valuable illuminant from which it is formed.

The retort house offers an interesting field of study. Present methods are not perfect. The thermo-chemical reactions in the retort are not as yet thoroughly and generally understood. But they are now the subject of earnest consideration among gas engineers. Resulting from this, we shall see the adoption of improvements in retort house practice. We shall see the removal of the difficulties which now militate against smoothness of bench operation. We shall also see the accomplishment of better carbonizing results, as our carbonizing methods advance to a more scientific basis.

A Sample Network of Pipe and Other Matter.

The great amount of work and attendant worry obligatory to maintain the supply of gas, water and electricity where subways, underground railroads and the like are being constructed, is well illustrated in the picture herewith, which shows the conditions that have existed for many months at the point in Brooklyn where Flatbush avenue, Fulton street, Hudson avenue and Nevins street intersect. Practically all of the sub-surface structures have to be relaid, and the elevated constructions upheld, much to the loss of the Companies and more to the temper of the pedestrian, since the tasks can only be performed in small sections.—"O."

Intersection Flatbush Avenue and Fulton Street, Brooklyn, N. Y.

1. "Pitch in Hydraulic Mains;" B O. Tippy, American Gas Light Journal, March 20, 1899.

Working Standards of Light and their Use in the Photometry of Gas.[1]

[A paper read by Mr. Charles O. Bond, before the Franklin Institute.]

This paper will deal with such standards only as are generally used in testing the illuminating value of gas produced in this country.

It is well first of all to define clearly what is meant by the unit of light as understood by gas people. It is the average light, measured in a horizontal direction given by Parliamentary sperm candles prescribed by the British Metropolis Gas Act of 1860, said candles to be 6 to the pound and burning 120 grains per hour. This, of course, would not refer to 1 candle but to the average of many candles; for candles differ in light giving value over a considerable range. This unit, it is clear, could not be definitely set aside for reference until there appeared a light source of sufficient constancy to be competent to preserve this unit when once its value had been incorporated in that source.

The first lamp which undertook this office was the pentane air gas flame, devised by A. Vernon Harcourt, this flame being maintained as seen by the screened eye at a constant height of 63.5 mm. and the fuel supply coming from a definite mixture of air and pentane vapor contained in a small holder. This flame was naked, of approximate shape of the candle flame and received its fuel without the intervention of a wick. Furthermore, its value through height regulation had been so adjusted as to give a light exactly equal to the average of many candles. This is an important point, for in later years when the effects of atmospheric changes upon the various flames were studied, it was seen that these two flames being so similar, would be nearly if not quite equally affected.

The London Board of Trade Committee on Photometric Standards, appointed in 1891 and reporting in 1895, were so confident of the worth of the pentane air gas flame as to state:

"5. We find that the 1-candle light flame proposed by Mr. A. Vernon Harcourt as giving a standard light and commonly known as the 'Harcourt Pentane Air Gas Flame,' when used under the conditions defined, does constitute a very exact standard, capable of being reproduced at any time without variation of illuminating value.

"6. We have satisfied ourselves that the light given by Mr. Harcourt's above mentioned pentane air gas flame as defined, in respect to the conditions of its production in the Appendix (Sec. III.) is a true representative of the average light furnished by the sperm candle flame constituting the present standard. * * *."

1. *Journal of the Franklin Institute.*

The elaborate determinations covering a period of 13 years over which this pentane air gas flame had been tested against the average candle and from which the Board of Trade Committee satisfied themselves were as follows:

Date.	Observers.	Value of Air Gas Flame in Standard Candles.
1879....	Vernon Harcourt	.994
1879....	Livesey and Brown	.990
1881....	H. B. Dixon	.998
1887....	British Association Committee	1.016
1888....	" " "	1.006
1891 ...	Greville Williams	1.008
1891-2..	H. B. Dixon	.998
	Average	1.001

These facts and quotations are cited because it has been the custom for the illuminating gas industries of this country to follow the methods set by the London Gas Referees, especially in photometric affairs. So that, while in 1895 the unit of light still officially resided in the average sperm candle, there existed another source where one could go and obtain its value far more readily. Yet this air gas flame with its attached holder lacked the portability of the candle, and so another effort was made to place the unit in safe but portable keeping. Mr. Harcourt proved to the satisfaction of the Referees that he had devised such a lamp in 1897, called the 10-candle pentane lamp, and the Referees adopted it at the assigned value of 10 standard candles.

If custom is to be followed, therefore, the unit of light as understood to-day by the illuminating gas industries of the United States is 1-tenth of the Harcourt 10-candle pentane lamp. There are in use in this country to-day over 150 such lamps, or American reproductions of them, and their use is extending rapidly. It is a good indication that the American gas industries desire a more intimate acquaintance with the unit, in order that more accurate photometry may result.

Standards of light are of three kinds: Primary, secondary and working. A primary standard is one that may be built and operated from a written specification. The chief quality desired is reproduci bility, even if this has to be obtained by infinite pains and for a short time only.

A secondary standard, once calibrated against a primary standard, must have the quality of constancy. It should also, if possible, be inexpensive, portable and easy to set up and operate, but not necessarily reproducible.

A working standard, as its name indicates, should be one adapted to the work in hand. It may be calibrated as often as desired or as is necessary.

Until recent years the gas industries of this country largely used the candle for each of the four purposes defined above; it was unit, primary, secondary and working standard all in one. And it may be said that the nearer a standard can come to fulfilling all these conditions accurately the more ideal it will be, except that the unit is small for practical measurements. With the exception of Violle's suggested primary standard, which is the light emitted from a square centimeter of molten platinum at the temperature of solidification, all the other feasible primary standards have depended upon incandescent carbon for their luminosity. This carbon may be in a fixed position and rendered incandescent by the molecular agitation produced through an electric current, or it may be in a free stream gaining its luminosity through the application of heat as in flames.

The attempt to preserve luminosity constant in flame standards is made in either of two ways: (1) By a uniform consumption of fuel; or (2), by the maintenance of a constant flame height. Granted a fuel of definite composition either of these methods would probably succeed were it not for changes in the atmosphere supporting flame combustion. The luminosity of the carbon particles, and consequently of the flame, is said to vary as the fifth power of their absolute temperature. Changes in the atmospheric component of the gaseous fuel mixture will, therefore, produce variations of flame temperature and hence of luminosity. So that, with the greatest care in specifying the construction, operation and fuel for these primary standards of the flame type, it has not been possible to secure the reproducibility of a given light value to within less than a range of 3 per cent. The Reichsanstalt in Germany will certify lamps (Hefners) that come within 2 per cent. above or below as regards their light value as compared with that of the standard lamp.

Out of 64 pentane lamps that have been standardized by the photometer department of the Philadelphia gas works 8 have fallen more than 1½ per cent. from the normal as compared with an imported English pentane lamp certified by the Secretary of the London Gas Referees, and 3 of these were found to have done so through faults in construction. As indicative of the constancy of pentane lamps upon intercomparison I will cite an instance: English Lamp, No. 51, was imported from London, January, 1900, having an ascribed value of 10.0055 candles, sealed and certified by W. J. A. Butterfield as compared with one of the lamps proved by the Referees to give a value of 10 candles. On May 13th, 1904, this English lamp 51 (value 10), imparted a value of 10.04 to American lamp No. 2 as an average of 60 readings. On May 17th, 1905, American lamp No. 2 (10.04) imparted a value to American lamp No. 89 of 10.02 as an average of 100 readings.

In the summer of 1907 this American lamp, No. 89, was taken to London, its value being unknown to the London Referees, and it was compared with one of their proved lamps of 10-candle value. Upon this test American lamp No. 89 had ascribed to it a value of 9.99 candles as against the above-mentioned value of 10.02, which it bore from calibration on this side of the water. This is a remarkable agreement, there being a discrepancy of only 3-tenths of 1 per cent.

It is apparent that the pentane lamp has the quality of constancy and is, therefore, able to act as a vehicle in conveying a given value to any of our working standards in gas photometry. Being constant for a given atmospheric condition, the original lamp in London may also be depended upon to maintain accurately the unit of light value. From these two considerations we see that it is now possible by means of good working standards to measure the quality of our gas in terms of the true English unit of light.

We will now consider the qualities which should be possessed by the ideal working standard and then proceed to the discussion of those working standards which are in general use in America. These requirements are:

1. That it should be readily portable, of simple construction and operation, and of unvarying dimensions.

2. It should have an independent fuel, reasonable in price and readily procurable, of definite chemical composition with a fixed boiling point.

3. The flame should be of the same order of luminosity as the test flame, of a similar color, fed without a wick, at a constant pressure, through a constant opening, and no chimney should intervene between it and the photometer disk.

4. The lamp should be burned in a quiet, adequately ventilated room of uniform temperature and be supplied with pure air of the same temperature. After reaching thermal equilibrium its flame height should be set and all the conditions named above having been complied with, the flame height and flame value will remain unchanged for that particular atmospheric condition.

5. It is known that all flames being supported in combustion by atmospheric oxygen are influenced by the condition of that atmosphere as regards carbonic acid content and water vapor content. It is desirable, therefore, that the luminosity of the standard used should, as far as possible, be influenced in the same direction and to the same extent as the test flame. In this way the correction in value is automatic.

Common Working Standards.—Reports were received by the American Gas Institute from the gas companies in about 80 of the largest cities in the United States, showing the following working standards to be in use:

A. British candles of several importations. Used by 31 of the 40 municipal and State inspectors, and by 41 gas companies.

B. Edgerton standard, used by 18 gas companies; no municipal or State inspectors.

C. Hefner lamps, used by 1 municipal inspector; 5 gas companies.

D. Electric incandescent lamps, used by 2 municipal inspectors; no gas companies.

E. Elliott lamp, used by 11 gas companies.

F. Pentane lamp, used by 31 gas companies and 3 municipal inspectors.

G. Jet photometers, variously manipulated, used by 28 gas companies, 20 of which also use bar photometers.

Of these working standards we may eliminate from consideration D (electric incandescent lamps), also G (jet photometers); D because no companies use it, and for the reason that it is unaffected by atmospheric changes and so is unsuited for testing gas flames which are so affected; G for the reason that, while by flame phenomena it serves to indicate the direction of change in candle power and can be calibrated fairly well, yet in the true sense it is not a photometer and makes no use of the light standards under discussion. In justice to the electric incandescent lamp it should be said that it is to-day the most trustworthy custodian of the unit of light, and is employed at the Bureau of Standards for that purpose.

A. *Candles.*—As a working standard these have back of them the weight of long usage, of being mentioned in many contracts, and of

general adaptability. They are still in the lead, numericatly, as a standard. They possess a light of correct color, they are cheap to transport. This is all that can be said in favor of them as a working standard. There is no doubt that the name "candle power" has had much to do with their retention. In single determinations, which is the function of a working standard, they do not prove constant. Hence, gas companies must allow a safe margin for their vagaries. Their average variation above and below normal, as thoroughly observed by the Dutch Photometric Commission, was 2.87 per cent., and individual variations were over 9 per cent. above and below normal.

Furthermore, the users of candles in this country are now in an anomalous position. One requisite in the past to make a candle of official value was that it should be certified by the London Gas Referees. For several years now the pentane 10-candle lamp has been the official standard in England, and it is not likely that the Referees are still certifying candles; yet we import them and trust to their being made in accordance with specifications. The last specifications for the purpose of securing uniformity in their manufacture were issued in 1894, and these were so minute that they have rarely been complied with by the manufacturers.

Not only is the candle specified - its weight, buoyancy, composition, material, wick, method of plaiting wick, its ash by weight after burning, melting of sperm, etc.—but a rigid method of burning them is laid down. In the warmer and more humid parts of this country it is next to impossible to comply with these regulations for burning them. They are particularly susceptible to the influence of moisture in the air, and in the warm days of last summer we made the attempt to put this humidity influence in the shape of a formula.

For Philadelphia, using the short candle of the "B. T. S." brand, we would say, candle power = 1 + .0087 (9.3 — e), where 9.3 liters of water vapor per cubic meter of dry air is normal, and where "e" represents liters found present. It is not expected that this formula can be applied to individual readings, but only to averages of a considerable number.

Mr. H. G. Bishop, of Baltimore, has furnished me with data concerning the grains of sperm consumed in 10 minute intervals, extending over a period of 8 years and averaged by months. This shows the effect of humidity very well.

Jan....40.08	Feb... 40.07	March ..40.42	April ...40.55
May....40.42	June...39.18	July.....38.77	Aug.....38.62
Sept....39.46	Oct ... 39.94	Nov.. ...39.82	Dec 40.05

These are the results from large averages, running from 120 to 235 determinations in each monthly classification, so that all wide variations are smoothed out. The normal consumption of sperm for a 10-minute interval is 40 grains, and readings are discarded where the sperm consumption varies more than 5 per cent. from the normal. As seen from the above figures, the average consumption for the month of August is 3.5 per cent. below normal; so there must have been days, even in latitude 40° North, when it would have been impossible to secure a determination using candles if they had burned in normal accordance with humidity conditions. It would be rather discouraging to try all day for a correct determination of candle power with the certain knowledge that if the humidity did not decrease none could be obtained. The remedy would seem to lie in enlarging the limits of permissible variation from the 40-grain rate. But as the case stands, if the candle is accepted for a working standard the method of its use must be accepted also.

Candles imported from different sources differ in value, this difference being in some cases as much as 7 per cent. The number of threads per strand of the wick differ, the melting point varies, the curvature of the wick during burning has an important bearing on the luminosity of the flame, its temperature being affected.

In spite of these damaging facts many people have an abiding faith in the accuracy of these candles as a working standard, and when in comparison with some other standard there occur irregularities, they are quick to attribute them to the other standard. In order to cover this phase of the argument I selected from 30 boxes of candles 1 candle each, and, arranging them in pairs, tested the 15 pairs against each other in a comprehensive manner. In this way I obtained the average relation existing between the pairs and found that the highest variation above this was 11.5 per cent. and the lowest was 7.5 per cent. below. It is plain, therefore, that the fault lay in the candles themselves.

Finally, it cannot be claimed that the manipulation of the candle in making the determination of illuminating value is either simple or easy. There is the trouble of cutting it in two and waiting for the cups to form properly; its adjustment of flame axes to a correct position and distance from the light under comparison, for the wicks twist about as they unbraid; the nice adjustment of the balance and the anxiety of watching for it to turn; the flickering of the flame caused by the minutest draft; the necessity of raising the candles in their holder as they are consumed.

For the reasons enumerated above it is difficult at this time to justify the use of candles as a standard of light except when the average of a great number of determinations is used; or when little accuracy is required; or when the place of test is so remotely located as to make other standards not feasible, or else legislative or contract obligations force their use.

[To be Concluded]

On the Comparison of Public Street Lighting Effects.

[By Mr. W. H. Y. Webber, in *Gas World*.]

It is very desirable at the present juncture, when the electric lighting interest is excusably bent upon making a strong bid for the recovery, by the agency of the flame arc lamp, of the public street lighting, which the open arc lamp is losing, that gas engineers and others concerned in the matter should form a settled judgment regarding the data upon which rival methods of public street lighting by electricity and gas ought to be compared. Apart from such questions of taste as whether the full orange-colored flame arc, a primrose-colored flame, a white (open) arc, or an incandescent gas mantle has the most pleasing appearance, the superiority of the first named, or the first two, is invariably rested by electricians, first, upon their high luminous intensity, and, secondly, upon their peculiar polar light distribution. The flame arcs take the same quantity of electricity as the ordinary open arc lamps, which is about half a unit per hour, for the usual 10-ampere size. Thus, the former have no advantage whatever in this respect, whilst, on the other hand, they are at least thrice as expensive in carbons and wear and tear. But it is claimed for them, and the claim may be allowed, that they are from three to four times as efficient in respect of the conversion of current into luminous intensity, and have a more favorable polar distribution. The latter is a very important consideration, which has hardly received due recognition in connection with the employment of high power, or, indeed, any lamps.

Photometry, as applied to determine the illuminating power of gas, originally referred simply and solely to the luminous intensity of the horizontal ray proceeding from the illuminant. It is quite correct to call the result of this measurement the illuminating power of the *gas*, as compared with the standard against which the horizontal luminous intensity is balanced; because every variation of the luminosity of the gas appears in this selected ray of light. It was natural to transfer the same method of light measurement from the *gas* to the *burner;* but this change concealed an opening for misunderstandings. Gas may be justly rated as of 16 or any other candle power; but it may not be strictly accurate to speak of the burner used for making the measurement as merely a 16-candle power burner. It will be so, for purposes of comparison, if the radiation of the light is equal in all directions, and if the comparison is with another source of a similar property in this respect. Thus, a standard test burner, whether Argand or flat flame, really gives as much more light than a standard candle as the illuminating power of the gas burner by it applies; because both lights are freely radiating into space, and have practically the same polar distribution. At any rate, this is true of Argand burners and candles. It begins to cease to be true with regard to flat flame gas lights and carbon incandescent electric lamps, which give more light from their flat sides than from their edges, in the horizontal direction. The difference, however, is not of great practical importance in either case, as these lights are commonly viewed from all directions.

"*Polar*" *Light Distribution.*—When the polar distribution of light from a source departs widely from the spherical, it clearly becomes important to take account of the degree of this divergence, and to correlate it to the purpose for which the light is required. The greater the difference from equal spherical radiation, and the more intense the luminosity of the rays in question, the more important it becomes to take this characteristic into account in comparing different sources. An example in point is the difference between upright and inverted gas burners; the former showing nearly the whole of the light horizontally, and within angles of 35° above and below the horizontal, with a slight preponderance above it, whereas the latter show most light in the lower hemisphere. This is speaking for the bare mantles, without reflectors or shades. In practice, however, the inverted mantle invariably has a more or less effective top reflector, which may help, to a small extent, its downward radiation, but is powerless to increase the horizontal intensity. For it is obvious that a reflector can only have the later effect when its disposition with relation to the total spherical radiation is such as to enable it to reinforce some rays at the expense of others. Thus, in the case of an upright mantle, all the radiation proceeding upwards above a determined angle can be reflected outwards instead by a convex superior reflector (Fig. 1). This shows a proper disposition of the top reflector in a public street gas lantern. It has been observed that the most useful direction of the light of any public street lamp is at angles of not less than 6° below the horizontal passing through the source; for then it strikes the street level somewhere within a useful distance, governed by the height.

With regard to high power street lamps, it is of the first importance to ascertain the effect of their polar distribution of light, in relation to their height and spacing. In the upright incandescent gas burner,

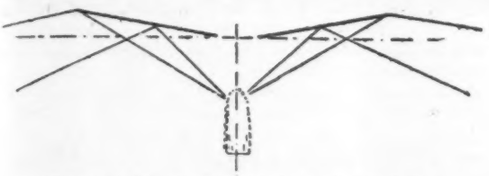


Fig. 1.—Upright Mantle with Convex Top Reflector.

as already stated, the maximum luminous intensity is produced horizontally or slightly upwards; which circumstance lends itself perfectly to the intensification by top reflection of the rays depressed through an angle of 5°. Therefore, if the photometrical horizontal intensity of such a source is, say, 1,000 candles, this will be reinforced by the valuable amount precisely in the direction where it will do most good. From the height of 20 feet the 5° ray will strike the ground within 74 yards. Roughly, every foot of vertical elevation of the source means 10 feet in the range of the 5° downward ray. The 10-ampere open arc lamp, the inclined carbon arc lamp ("Oriflamme"), and the "Crompton-Blondel" yellow flame arc have distribution curves as in Fig. 2. The disappointing character of the first and second sources is explained by their defective polar distribution. Plainly, outside a ring with a radius corresponding to an angle of 50° at most with the vertical, these lamps show a great falling off. Even the Crompton-Blondel flame arc confines its superior brilliancy to the circle round the vertical passing through it which is described by the angle of 70°. Assuming such a lamp to be 28 feet above the ground (as the experimental lamps in Cannon street), which is quite as high as it could be seen through a fog, its maximum luminous intensity would fall off suddenly at a distance of 81 feet to the ground. At this radius the illumination in candle feet, according to the figured intensity, works out at 0.38. At the angle of 80°, which strikes the ground 158 feet away, the original intensity of the lamp is apparently not more than 1,000 candles, and the illumination in candle feet therefore falls to 0.04. Therefore, in order for the best advantage to be derived from the polar distribution of Crompton-Blondel flame arc light, the lamps, 28 feet high, should be near enough together for their 70° rays to meet at the ground level—that is, they should be spaced not more than 50 yards apart.

The above calculation assumes the correctness of the value ascribed to the particular flame arc lamp. In the case of most lamps of the kind in service, however, the luminous intensity is rarely so high, and fluctuates very noticeably. Measurements of flame arc 10-ampere lamps actually in operation in a London thoroughfare betray variations of from 2,500 to 1,300 candles maximum intensity. It is, therefore, impossible to credit them as regularly giving the high efficiency shown by the best example in Fig. 2. Even so, there would remain the question of what intensity of luminosity is the most suitable for a particular case of public street lighting, having regard to the permissible height of the lamp columns (or suspended lanterns); to the polar distribution of the light; to the ratio between the brightest and the darkest spots; to the trustworthiness and convenience of the means proposed; and to the cost. Other questions, of taste, and the influence of the color and composition of the spectrum of the light, will also arise with reference to particular cases.

The Convention of "Candle Feet."—Although it is the easiest and most direct way to compare artificial lighting effects by working out the illumination to the convention of "candle feet," it is necessary to remember that this is a mere mathematical exercise, susceptible of being upset by several important practical considerations. It rests upon assumptions which are true for the purposes of the photometer room, but cannot all be taken for granted out-of-doors. Thus, the rule of inverse squares, which is the foundation of all comparative photometry, entails the neglect of all reflection effects, and assumes that the eye never catches sight of the source of light itself. How far this condition is from being fulfilled in the streets needs no demonstration. The fact is very obvious; but not so clear is the extent to which the usual calculation is vitiated thereby. Dr. Louis Bell remarks on this point: "This law of inverse squares is broadly true of every case of the free distribution of energy from a point within a homogeneous medium. * * * It does not hold in considering a radiant surface as a whole, nor for any case in which the medium is not homogeneous within the radii considered. By reason of these limitations, in problems of practical illumination the law of inverse squares can be considered only as a useful guide, for it is far from infallible, and may lead to grossly inaccurate results. It is exact only in the rare case of radiation from a minute point into space in which there is no refraction or reflection." Dr. Bell goes on to point out that a search light is outside the rule; here there is a source of radiation; but as many as possible of the rays are reflected and refracted by lenses so as to form a nearly parallel beam, which preserves its luminous intensity to a great distance from the apparatus. If the beam were composed wholly of parallel rays, its luminous intensity would continue unabated to any length, save as diminished by atmospheric absorption, which varies enormously with the state of the weather. What is true of search lights, magic lantern lights, etc., is also true, so far as it goes, of all reflector lighting, in which the free spherical radiation is modified. Other considerations affecting the simple mathematical rule of free radiation arise out of the different dimensions and color of the radiants.

The single circumstance of the lamps which light the streets being always in full view of the wayfarers discounts enormously the practical value of calculated or measured minima, when the street lighting units are near enough together for several to be seen at once. The eye instinctively seeks the light, and, provided the dark spots in the middle of the road are not too extensive, does not, in point of fact, notice their existence.

The eye, moreover, as is well known, is incapable of directly comparing by inspection the brightness of one light source with that of another in the field of vision. Consequently, if a perspective of a number of brilliant lamps, such as electric arcs, is viewed together, the impression conveyed is that of bright lighting, which might not be borne out by reference to the photometric values. When the spectator's eye is situated just short of a brightly illuminated spot surrounding a powerful lamp overhead, he cannot see distinctly through and beyond this brightly illuminated region. And as soon as he moves past the nearest lamp he looks towards the next. Thus the impression respecting the quality of an example of street lighting which is formed in the wayfarer's mind is largely influenced by the fact of its being a moving panorama to him; and if he, being a non-technical person, were told of the method by which the merit of the installation is judged, according to the rule and practice of the photometer room, he would be justly surprised.

Criticism of the Portable Photometer for Illumination.—It is to be doubted if the employment of the portable photometer for the measurement of the quantity of light existing diffused in a street is quite trustworthy as a check upon the calculated effect of the lamps. As a means of checking the stated intensity of the luminants themselves, the portable photometer, properly used, is of value. When it is sought to ascertain, by actual comparison with a portable standard of light, the intensity of the illumination received upon the screen of such an instrument, as viewed by an observer, the trustworthiness of the determination is open to criticism on several counts. Such points as that of the proper height of the screen from the ground, and the sensitiveness of the method of balancing the lights on the low scale of intensity prevailing over the greater part of the field of operation in which the traffic circulates, appeal to everyone. It does not appear that any instrumental arrangement hitherto available is adapted to accommodate all the effects of diffused illumination of which the vision of a passer-by naturally takes account. As Mr. A. P. Trotter observes, in the February number of the *Illuminating Engineer*, p. 97: "The foot-candle, as already defined, assumes that the illuminated surface directly faces the source of light. If the surface is inclined to the direction of the rays of light, the illumination will diminish in proportion as the projected area of the surface diminishes when viewed from the source of light. The visible surface varies from unity, as seen full, to nothing when seen on edge." This consideration is called by writers on the subject "the law of the cosine." It means, simply, that if the intensity of light falling vertically upon a surface is unity, that falling upon a surface inclined away from the line of the incident ray will be diminished as the cosine of the angle of incidence. It is a somewhat curious convention with writers on optics, as Mr. Trotter remarks, that they call this angle of incidence, not as the ordinary man would recognize it, namely, the angle between the path of the incident ray and the surface upon which it impinges, but the angle between such ray and the perpendicular to the surface, otherwise called the "normal." Thus, in the language of optics, a ray proceeding horizontally, parallel with the surface of the ground, is said to have 90 incidence; and a ray falling perpendicularly beneath a lamp is of 0° incidence on the ground.

It follows from the foregoing that the angular relations between a plane portable photometer screen and the light falling upon it may be illustrated as in Fig. 3. If AO represents the position of the screen

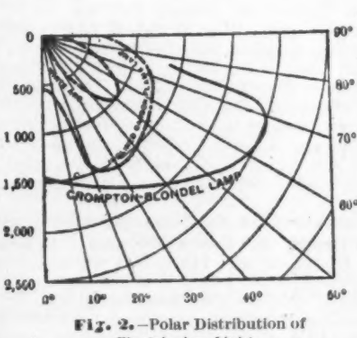


Fig. 2.—Polar Distribution of Electric Arc Light.

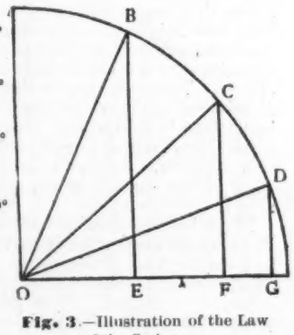


Fig. 3.—Illustration of the Law of the Cosine.

at right angles to the source of light, then it is getting all the radiation possible, for the angle of incidence is 0°; and the cosine of 0° is 1. The lengths of the perpendiculars, BE, CF, DG, in proportion to the length AO, indicate the decrease of illumination received by reason of the slope of the surface, being so much less than unity as the inclination increases, until at incidence 90° it is 0, and the illumination accordingly falls to *nil*. It is evident that no portable photometer screen having a plain surface can be so manipulated in any situation receiving illumination from several sources as to do justice to all. Perhaps if the screen were covered with a hemispherical lens, it would nearly resemble the light-collecting human eye; but that is a question for opticians. At any rate, the plane portable photometer screen, at whatever angle inclined, cannot receive on equal terms all the diffused illumination proceeding from more than one lamp.

If the ordinary portable photometer screen is a bad substitute for the human eye in testing diffused street lighting effects, the photographic camera is worse. No photograph of an uneven lighting effect which includes the lamp in the field can do justice to the scene as viewed by the eye, because actinism is not vision. The lamp is always excessively irradiant, and the dark places too gloomy. The human capacity for perceiving objects has no photometric equivalent. On the contrary, vision is at its best under artificial conditions where the actinic plate is blind. If perception is measured by its power with different colored lights, then, taking yellow light as unity, it falls to 1-twentieth for green, and 1-sixtieth for blue—exactly opposite to the scale of activity of actinic light. The defect of strong yellow light is that it destroys all other color in the objects illuminated.

The Question of Maximum Luminous Intensity.—The most important of all the questions of public street lighting, which *is* lighting, however, and not the beacon light service which comprises by far the largest division of this concomitant of urban civilization, is that of the most suitable luminous intensity for the lamps, in the local circumstances. It cannot be said truly that any general agreement has yet been arrived at as to what value or meaning should be attached to the results of the measurement of diffused street lighting by portable photometers. One observer sets store by uniformity of diffusion, which another derides. Another holds that high average illumination is the thing that tells with the public, irrespective of the amount of difference between the maximum and minimum effects. Mr. Kenelm Edgcumbe says: "Just as the area of an indicator card represents the work obtained from a given amount of steam, so the area of these illumination curves shows the illumination obtained from a given amount of gas or electricity." He is speaking of the diagrams in which computed or observed luminous intensities, as the case may be, are plotted out for the distances, measured along the curb or along the middle line of the street, according to the taste and fancy of the operator.

The accompanying diagram (Fig. 4) is from originals by Mr.

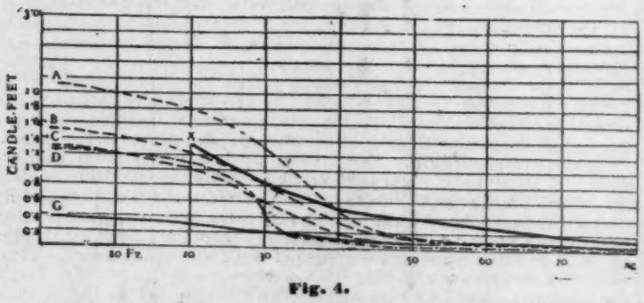


Fig. 4.

A. Oxford street, flame arcs (2). *B.* Whitehall, flame arcs (1). *C.* Cannon street flame arcs (1). *D.* St. James street, open arcs (1). *G.* Kingsway, 3-mantle gas lamps (7). *X.* 1,000-candle power gas lamps, computed.

Kenelm Edgcumbe and the *Electrician*, for the electric lamps, and the measurement of the effect of the 3-mantle, high pressure gas lamps in Kingsway, which Mr. Edgcumbe rates at 550-candle power. An addition has been made of a line (*X*) showing the computed effect, in candle feet, of a 1,000-candle power gas lamp, as radiating along the angle lying between 5° and 15° below the horizontal passing through the center of the mantles. The lengths are taken diagonally from the height of 22 feet to a point 4 feet above the ground, at the horizontal distances given. That is to say, 20 feet on the scale means a point 4 feet above this length of kerb from the vertical passing through the lamp post, which is assumed to show its light at the height of 22 feet above the roadway. It will be perceived that at the distance of 80 feet the illumination is 0.15 candle foot, which is higher than the electric lamp effects. This is owing to the better distribution of light from mantles, aided by slightly convex top reflectors. Another interesting point to be noticed is that at any distance farther than about 60 feet the measured illumination curves from the different electric and gas lamps run together. From which it is to be inferred that, from the point of view of the distant effect, the higher original intensity of the flame arcs is of no avail.

There is no generally accepted standard of sufficiency for distributed lighting between public street lamps. Dr. Louis Bell puts it at about 0.03 candle foot, presumably from a single lamp. It appears, however, that in all the examples cited in this paper this minimum is considerably exceeded. Most people can see the time fairly well by a white watch dial with an illumination of rather under 0.1 candle foot. The broad result of the considerations here set forth seems to be that the choice between electricity and gas for street lighting, on the most lavish scale, remains open, notwithstanding the advent of the extravagant yellow flame arc lamps. Beyond the lineal distance of 40 feet away even a pair of these lamps, as used, regardless of expense, in the axial lighting of Oxford street, are surpassed in effect by a 1,000-candle power gas lamp; whilst at 60 feet, which is still very close to the lamp post, all lights of 500-candle power fall into the same order of efficiency as illuminants. It is impossible to accept Mr. Edgcumbe's suggestion that the lighting curves thus plotted are analogous to the indicator diagram of a steam engine. The squaring of one quantity in this case destroys the comparison, and it would unduly favor lamps with the worst distribution figure. The flattening out of the line of luminosity with increasing distance from the light source, due to the diminishing difference of the quotients of division of a number by squares of the distances as these increase in magnitude, favor lights with the best horizontal distribution.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE Massachusetts Board of Gas and Electric Light Commissioners has under advisement the petition of the Haverhill (Mass.) Electric Light Company for leave to increase its capital stock in the sum of $150,000.

THE annual meeting of the Utica (N. Y.) Gas and Electric Company will be held at noon to-day.

THE Block Light Company, of Brooklyn, N. Y., is considering the advisability of removing its factories to Youngtown, O. The Block Company is now the owner of the rights and business of the Cremo Light Company.

THE shareholders of the Charlestown (Mass.) Gas and Electric Company are generally exercising their privilege of subscribing for one share of the new stock (2,000 shares) to each 5 shares of old stock held by them. The subscribing time limit expires next Monday, and the Transfer Agent is the Boston Safe Deposit and Trust Company. Payments are operative in two installments; 60 per cent., the first of June, the balance the first of August.

MR. LEWIS H. SCULL, a well-known and valued employee of the Consumers Gas Company, of Reading, Pa., died at his home in that city some days ago. He was in his 61st year, having been born in Reading, October 28th, 1847.

MR. R. D. RUBRIGHT, formerly Chief Clerk in the general accounting department of the New York Consolidated Gas Company, has been appointed Auditor of the Westchester Lighting Company, with headquarters in Mount Vernon, N. Y.

AT the next municipal election in Aurora, Neb., one of the questions of moment to be voted upon will be the proposition to issue bonds for the construction and operation of a municipal gas plant.

ALL hail to the Chief, the exordium being prompted by the information just at hand that Mr. Carroll Miller has been appointed to the post of Engineer to the Consolidated Gas Company, of Pittsburgh, Pa. Mr. Miller will not relinquish his work in the field of consulting engineering. Captain "Nat." McKay will please take notice.

THE makers of edge tools long ago learned the lesson of forming their tools in graceful shapes and setting them off with almost brilliant polishes, rounding the device out with an attractive handle. Possibly the makers of tools for use on iron work, particularly perhaps in the gas and water trade, have not been as far advanced as those who had to do with finer first materials. To be sure, the nature of the work in and on these did not seem to call for the finest, but a change is surely manifest. This mention is brought about through having recently seen a set of calking tools, in a certain gas works' shop not far from 42 Pine street, that had just been received from the shops of the H. Mueller Manufacturing Company, of Decatur, Ills. The set consisted of 9 pieces, and they certainly were striking examples of painstaking manufacture. Nor is substantiality in any sense overlooked in the striving for beauty. The tools are hand forged from the best ocatgonal tool steel, each point having been ground to a certain gauge and tempered to the right degree of hardness. Indeed we have no hesitation in saying that the Mueller goods are like unto temper and quality, and that the Company's office in New York city, is a showroom in which the skilled artisan will find much to inspect that will cause him to prolong his visit there, once he happens in.

THIS is given for what it is worth—it is taken from a recent issue of the Philadelphia *Ledger*—and we have been told that the scribe referred to was the only "Dave." "The United Gas Improvement Company people, a large group of them at that, who have been holding their annual convention in Philadelphia this week, went to Atlantic City for an outing the last day of their convention. They registered at the Shelbourne, and one scribe did the pen work on the hotel blotter. Later on a woman, in looking over the book, in calling the attention of a friend to the signatures, remarked: 'Oh! How odd. All these people must have gone to the same school; they write so exactly alike!' Well! well!!"

MR. C. WELLINGTON KOINER, having resigned the position of General Superintendent and Engineer to the Los Angeles (Cal.) Gas and Electric Company, has been engaged to unravel the tangles of the

Passadena municipal lighting plant, as its General Manager and Engineer.

At the meeting for organization of the Board of Directors of the Ludington (Mich.) Gas Company Mr. W. F. Doelker was re-elected Manager. It is natural to suppose that such would have been the case, when one recalled to mind that the Company's output for the year, or since Mr. Doelker took hold of its affairs, shows a gain of 33 per cent.

The Editor of the monthly gazette of the Suburban Gas Company, of Chester, Pa., is at it again in the April issue of "Gas-ps"—such is the title of the print—as witness the following: "Strange how the stork generallv manages to dodge the wolf, when he is at the door!"

"This winter the Mifflin County Gas and Electric Company, of Lewiston, Pa., offered three prizes to the pupils of the Lewiston High School for the three leading essays on the Lewiston gas works, accompanied by notes on the manufacture of carburetted water gas. The pupils took great interest in the work, many of them visiting the works several times during the period in which they were preparing their essays, which mere fact alone gave us considerable valuable advertising. The prizes were, respectively, $7.50, $5 and $2.50. The first prize was awarded to the manuscript signed Regis Noel, the successful aspirant being a lad of 16 years. We are indebted to the courtesy of the Company's General Manager, Mr. E. F. McCabe, for a copy of the prize winning paper or thesis, and it certainly is a very creditable bit of work.—R."

At the hearing before the Massachusetts Board of Gas and Electric Light Commissioners on the petition of certain residents of Leominster, Mass., that the rates charged by the Leominster Gas Light Company be ordered reduced, it was proved by the Company that 51 of the signers of the petition did not use gas for any purpose whatever.

The Piqua (O.) Blower Company appears in the columns of the Journal for this week as an advertiser for the first time, although it has been actively in business since 1905. However, the individuals who compose the Company have been connected for years with other leading manufacturers in this line as employees, and they certainly are competent to design, build and erect apparatus of the nature that is advertised.

An ingenious device for the camera in the field of reading gas and electric meters is proposed by Mr. S. C. Shaffner, former Superintendent of the Mobile (Ala.) Electric Lighting Company. He has applied to the U. S. Patent Office for Letters of protection for the device. We have not seen a model of the apparatus, but the following description thereof was published some days ago in the "Bulletin of Photography:" "The camera is 12 inches long by 6 inches wide and 7 inches high, fitted with a specially constructed lens. The light is derived from 6 small flash lamps contained in the camera case, the current being furnished from dry cells, also suitably inclosed. The meter taker sets the camera against the front of the meter dials and pushes a button. The current turns on the lights, opens and closes the shutter and cuts off the lights after the exposure is made. The releasing of the button turns the sensitized paper roll ready for the next exposure. The sensitized paper roller carries a roll 60 feet in length and about 3½ inches in width. About 2 inches of the paper answer for an exposure. When the meter taker turns in his camera at night the used spool of film is put in an automatic developing table, where the roll is run through the developer and washed and fixed. That operation is done at the speed required to properly develop and fix the films, and for this purpose developing pans 5 feet in length are used, the film being kept traveling through them at the proper speed by means of a small electric motor. Just before the film is wound on the spool it is passed several times back and forth under the table, where it is dried by the air from a pan. Next it is read by the bill clerk to get the readings for making out the bills. The roll is then numbered and filed for future reference, should any contention between Company and customer arise. The camera is also equipped with a device whereby on each reading the number of the meter with date and time of making the reading is stamped."

The Holland, Mich., authorities have about determined to extend the conveying mains to the outlying districts of North Shore and Zeeland.

Mr. S. E. Wolf has been elected Second Vice-President of the Bay City (Mich.) Gas Company.

The authorities of Greenville, O., have extended the franchise of the Greenville Gas Company for a period of 25 years. It is likely the plant will be reconstructed.

The payment to the city of Tampa (Fla.) by the Tampa Gas Company on account of franchise tax on its gross receipts for 1907 amounted to $946.41. The franchise was granted in 1905, and so far under its workings Tampa has been paid $2,039.

Mr. Robert Thompson, of Philadelphia, has been appointed Manager of the Kenneth (Pa.) Gas Company, vice Mr. A. M. Hoch, resigned.

At a meeting of the Vincennes (Ind.) Board of Public Works it was shown that the Shaffer natural gas properties in that city had been secured by the local gas company, for a petition was presented to the Board asking that the Vincennes Light and Power Company be granted the right to furnish natural gas to the eity. The old Vincennes Gas Light Company is a member of the Vincennes Light and Power Company.

The Williamstown (Mass.) Gas Company has taken possession of its handsome new business headquarters, which are located in Azderian and Chambers block. The new quarters are as attractive as the others were—well, they were not as attractive.

Mr. Harold F. Rogers has been appointed superintendent of the meter department of the Norwich (Conn.) municipal gas works. He was formerly in charge of a similar division of the works of the Manchester (N. H.) Traction, Light and Power Company.

"T. L. W.," writing from St. Paul, Minn., under date of the 26th ult., says: "Dear Journal: You have, of course, printed quite some time ago the agitation accounts which eventually resulted in the employment of a city gas inspector here. The occupant of that office (Mr. R. H. Talbot) I am glad to say is in every sense a reasonable man, furthermore that he is well equipped by training and habit to carry on the duties of his office, without fearing or favoring, so his findings are accepted as accurate by the people and the Company. Since last fall 260 gas meters have been inspected by him on complaint—the law accepts as accurate meters that are within 2 per cent. fast or slow—and the tables show this. Those counted as accurate numbered 49, of the others, those varying between the legal limits numbered 138, which left 73 offending instruments; of the 73 the tables report 43 fast meters and 30 slow ones. The average error fast was 4 per cent., the slow, 3½ per cent. The tables, however, reveal one other thing that you may safely assure yourself was not brought out strongly in the columns of the 'Pioneer Press,' etc., in their publication of the tests. Not much! The omission was, as near as I can get at the figures, something like this: The slow meters were passing an average of 350 cubic feet per diem, whereas the fast meters were averaging a register of 310 cubic feet. Now, who was getting the worst of it? The St. Paul Company has, I believe, 21,542 meters in use, and I venture to say that meters of no other Company in the West are taken care of with greater diligence."

Mr. F. D. Cadwallader, of Chicopee, Mass., has been appointed on the new business staff of the Greenfield (Mass.) Gas Light Company.

Under the direction of Manager Charles F. Prichard, of the Lynn (Mass.) Gas and Electric Company, its generating plant will be considerably enlarged this summer. Plans have been drawn for an extension to the present retort house, of the dimension of 100 feet by 60 feet by 50 feet in height, and contracts have been awarded for the placing therein of 2 benches of 6's on the inclined plan. We are not positive as to the constructors of the retorts, but are reasonably certain that the work will be done by Mr. Frederick J. Mayer, sole representative in this country of the Dessau Vertical Retort Bench Company.

The Consolidated Gas Company, of Pittsburgh, Pa., has notified its shareholders that hereafter a dividend of 4 per cent. on their stock per annum is guaranteed by the Philadelphia Company. Two per cent. will be paid August 1st and February 1st. No dividend has been declared on these shares since August 10, 1906.

The Texarkana (Tex.) Gas and Electric Company has declared its intent to double its capital stock—that is, to make the issue $200,000 instead of $100,000.

Corporation Counsel Desbecker, of Buffalo, N. Y., has consented to a discontinuance of a suit brought by the Buffalo Gas Company in the United States Court to enjoin the enforcement of the 95-cent gas rate heretofore ordered by the former State Commission of Gas and Electricity.

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NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

MONDAY, APRIL 6, 1908.

The Market for Gas Securities.

The net result over the trading in Consolidated gas for the week was a draw to every intent, the prices recorded at noon to-day (Friday) being 116 to 116¼. We have no hesitancy whatever in saying that every intimation and every indication, both in courts and in the Company, point positively to the fact that the current rise is only the beginning of a marked advance over the present figures.

Brooklyn Union is also strong, with little stock offered, and well-informed people in the instance of its doings are very bullish regarding it. Peoples, of Chicago, sold off just a trifle; the standing of the Company improves rapidly. Washington (D. C.) gas is again at 310, and no change is reported in Cincinnati. The gas bond market is again showing signs of animation.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.
16 WALL STREET, NEW YORK CITY.
APRIL 6.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share:

N. Y. City Companies.	*Capital*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	116	116¼
Central Union Gas Co.—				
1st 5's, due 1972, J. & J.	3,000,000	1,000	92	7
Equitable Gas Light Co.—				
Con. 5's, due 1932, M. & S.	1,000,000	1,000	—	105
Mutual	3,500,000	100	—	170
New Amsterdam Gas Co.—				
1st Con. 5's, due 1948, J. & J.	11,000,000	1,000	84	86
New York & Richmond Gas				
Co. (Staten Island)	1,500,000	100	37	43
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	—	98	104
New York and East River—				
1st 5's, due 1944, J. & J.	3,500,000	1,000	100	105
Con. 5's, due 1945, J. & J.	1,500,000	—	97	101
Northern Union—				
1st 5's, due 1927, J. & J.	1,250,000	1,000	90	98
Standard	5,000,000	100	70	100
Preferred	5,000,000	100	100	125
1st Mtg. 5's, due 1930, M. & N.	1,500,000	1,000	100	105
The Brooklyn Union	15,000,000	1,000	104	110
1st Con. 5's, due 1948, M. & N.	15,000,000	—	91¾	92
Yonkers	200,000	500	130	—
Out-of-Town Companies.				
Bay State	50,000,000	50	1	11-16
" Income Bonds	2,000,000	1,000	—	75
Binghampton Gas Works	450,000	100	—	65
" 1st Mtg. 5's	500,000	1,000	95	100
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	5	8
" " Bonds, 5's	5,250,000	1,000	63	66
Capital, Sacramento	500,000	50	—	35
Bonds (6's)	150,000	1,000	—	—
Chicago Gas Co. Guaranteed				
Gold Bonds	7,000,000	1,000	104	106¼
Cincinnati Gas and Electric				
Co.	29,500,000	100	90½	91
Columbus (O.) Gas Co., 1st				
Mortgage Bonds	1,500,000	1,000	92	98
Columbus (O.) Gas Lt. &				
Heating Co.	1,682,750	100	87	88
Preferred	3,026,500	100	81	82
Consumers, Toronto	2,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	—	103
Mortgages, 6's	3,600,000	—	—	118
Chesapeake, 1st 6's	1,000,000	—	—	—
Equitable, 1st 6's	910,000	—	—	—
Consolidated, 1st 5's	1,490,000	—	—	112
Consolidated Gas Co. of N. J.	1,000,000	100	15	17
Con. Mtg. 5's	880,000	1,000	92	95
Bonds	75,000	—	—	100
Detroit City Gas Co.	6,000,000	50	—	50
" Prior Lien 5's	4,618,000	1,000	—	98
Detroit Gas Co., 5's	381,000	1,000	75	80
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co.,				
Chicago, Bonds	2,000,000	1,000	—	101
Essex and Hudson Gas Co.	6,500,000	—	39	40
Fort Wayne	2,000,000	—	—	—
" Bonds	2,000,000	—	55	—
Grand Rapids Gas Lt. Co.,				
1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of				
New Jersey	10,500,000	—	100	105
" Bonds, 5's	10,500,000	—	101	102½
Indianapolis	2,000,000	—	60	70
" Bonds, 5's	2,650,000	—	104½	105
Jackson Gas Co.	250,000	10	82	—
" 1st Mtg. 5's	290,000	1,000	97	100
Kansas City Gas Light Co.,				
of Missouri	5,000,000	100	—	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	97	97½
Preferred	2,500,000	100	92¾	93
Bonds	10,000,000	1,000	104	104½
Lafayette Gas Co., Ind.	1,000,000	100	—	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	143	145
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	350,000	1,000	106	106½
" 6 per cent. scrip,				
due 1910	100,000	25	60	60½
Massachusetts Gas Compan-				
ies, of Boston	25,000,000	100	50½	51
Preferred	25,000,000	100	83	83¼
Montreal, Canada	9,000,000	100	218	218¾
Nashville Gas Lt. Co.	1,000,000	100	110	—
Newark, N. J., Con. Gas Co.	6,000,000	—	56	58
Bonds, 6's	6,000,000	—	137	138
New Haven	2,000,000	25	200	—
Peoples Gas Lt. & Coke Co.,				
Chicago	25,000,000	100	89	89½
1st Mortgage	20,100,000	1,000	—	—
2d "	2,500,000	1,000	104	—
Rochester Gas & Elec. Co.	2,150,000	50	88	—
Preferred	2,150,000	50	118	—
Consolidated 5's	2,000,000	—	104½	103½
San Francisco, Cal.	15,500,000	—	—	—
St. Joseph Gas Co.—				
1st Mtg. 5's	751,000	1,000	92	—
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgages, 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's	2,465,000	1,000	96¼	—
Syracuse, N. Y.	1,378,000	100	50	55
Bonds	2,047,000	1,000	102	—
Washington, D. C.	2,800,000	20	307	310
1st Mortgage, 6's	600,000	—	—	—
Western, Milwaukee	4,000,000	—	—	—
Wilmington, Del.	600,000	50	230	—

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO., N. W. CORNER BROAD AND ARCH STS., PHILADELPHIA, PA., March 11, 1908.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable April 15th, 1908, to stockholders of record at the close of business, March 31, 1908. Checks will be mailed.

1710-5 LEWIS LILLIE, Treasurer.

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1711-3 "GAS ENGINEER," care this Journal.

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Open for engagement after April 1st, 1908. Supervising central station installations, either gas, electric or general power equipment. Will take charge of the remodeling of old properties. Experienced in all branches of the gas and electric business. Can give references.

1711-3 Address, "ENGINEER," care this Journal.

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1711-3 Address, "M. C. B.," care this Journal.

Position Wanted

As Superintendent or Office Manager of Gas Works.

Qualified to take charge of water gas plant. Seven years' experience. Best of references furnished.

1713-1 Address, "A. M. H.," care this Journal.

WANTED,

Situation as Gas Meter Repair Man,

By a young man 33 years of age. Has had 10 years' experience and can furnish the best of references.

1714-1 Address, "L. B.," care this Journal.

WANTED,

A Position as Superintendent or Foreman of a Coal or Water Gas Plant.

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1712-2 Address, "M.," care this Journal.

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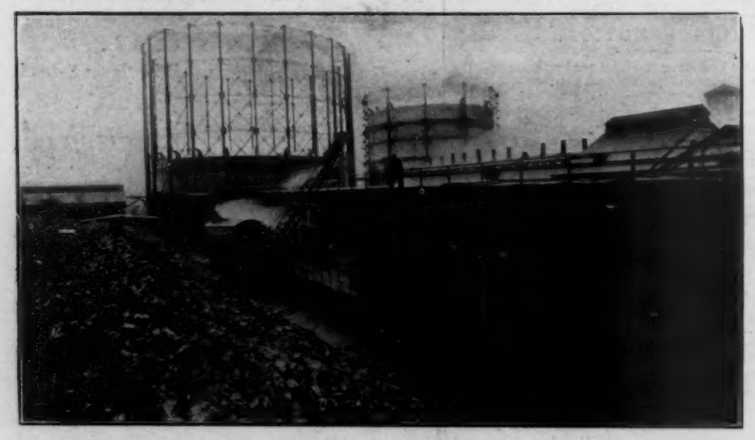

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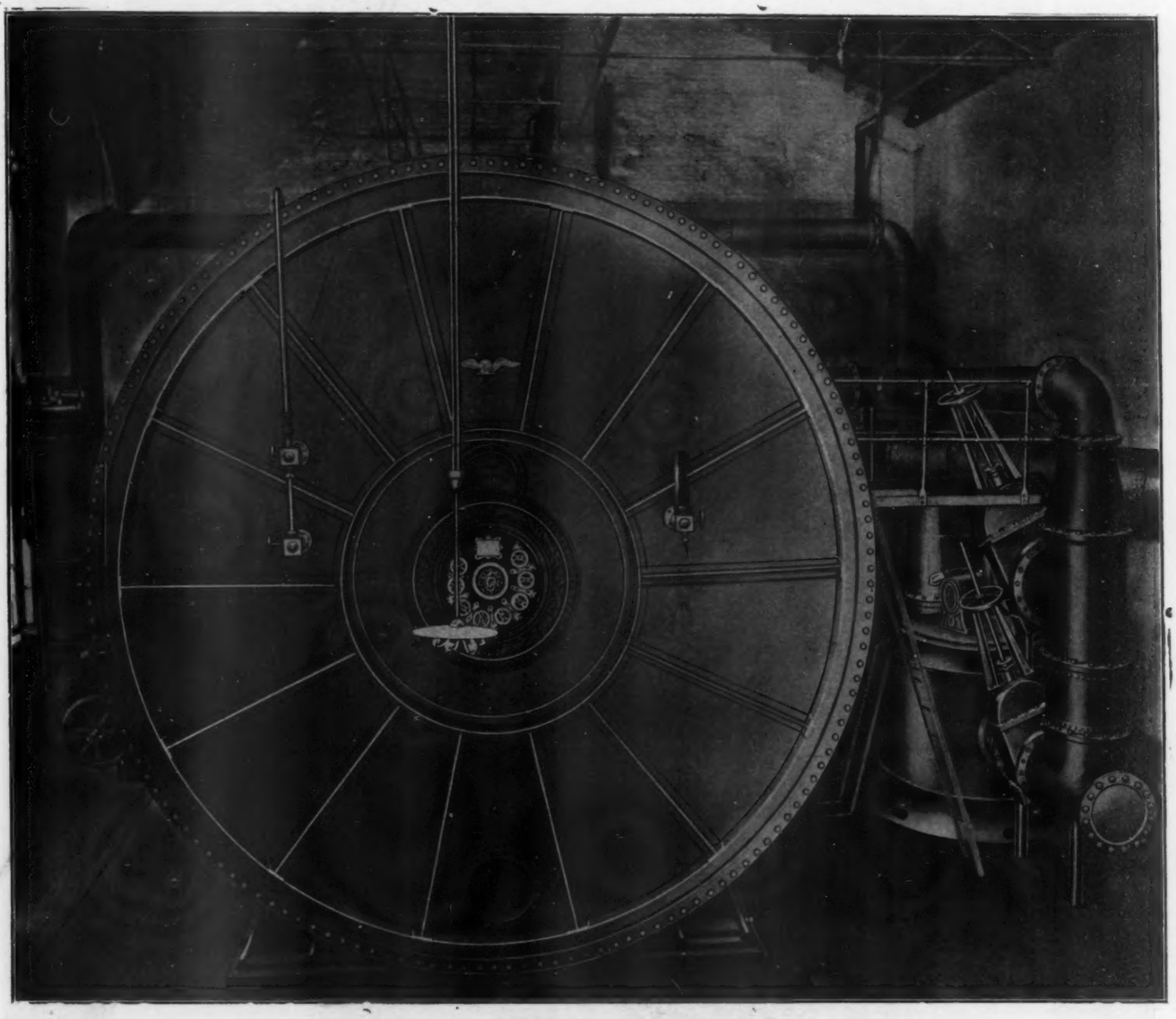

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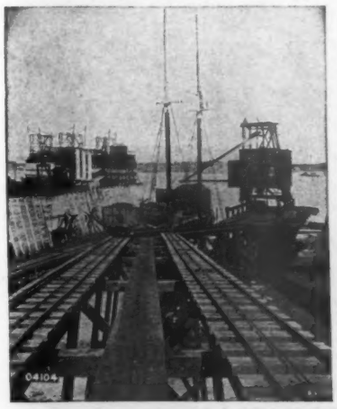

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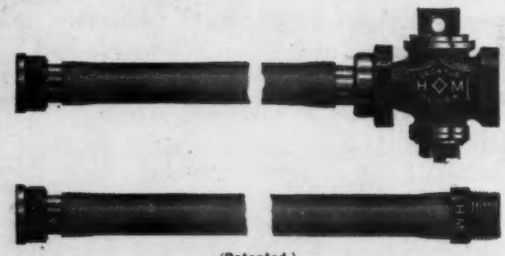

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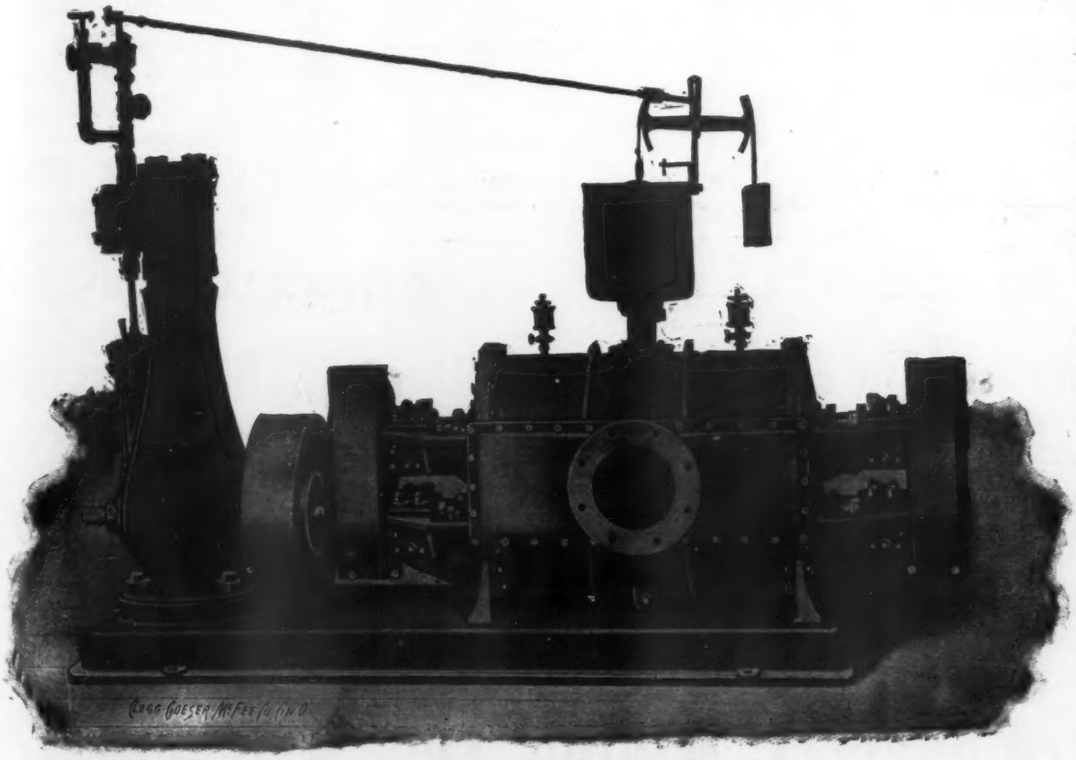

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PUBLIC LIGHTING TABLE.

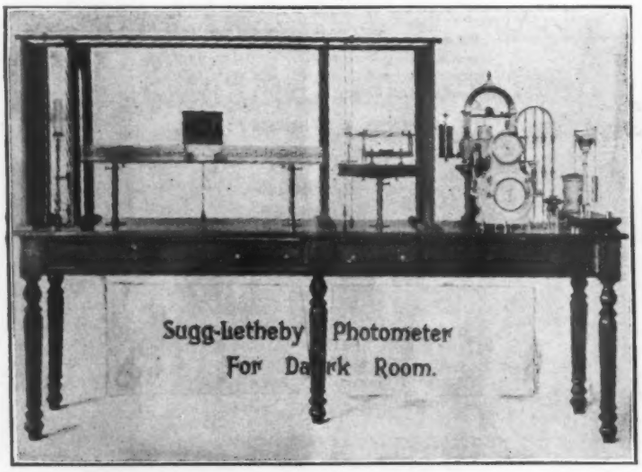
APRIL, 1908.

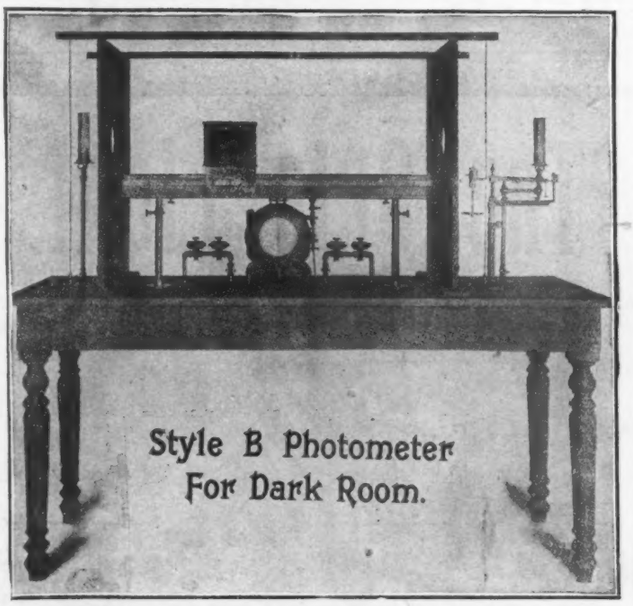
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.
Wed.	1	6.50 PM	4.40 AM
Thu.	2	6.50	4.40
Fri.	3	6.50	4.40
Sat.	4	6.50	4.40
Sun.	5	10.30	4.30
Mon.	6	11.20	4.30
Tue.	7	12 20 AM	4.30
Wed.	8	1.00 FQ	4.30
Thu.	9	1.40	4.30
Fri.	10	2.20	4.30
Sat.	11	2.50	4.30
Sun.	12	3.20	4.30
Mon.	13	3.50	4.30
Tue.	14	4.10	4.30
Wed.	15	No L.	No L.
Thu.	16	No L PM	No L.
Fri.	17	No L.	No L.
Sat.	18	7.10 PM	10.00 PM
Sun.	19	7.10	11.00
Mon.	20	7.10	12.10 AM
Tue.	21	7.10	1.10
Wed.	22	7.10	2.10
Thu.	23	7.10 LQ	3.00
Fri.	24	7.10	3.40
Sat.	25	7.10	4.00
Sun.	26	7.20	4.00
Mon.	27	7.20	4.00
Tue.	28	7.20	4.00
Wed.	29	7.20	4.00
Thu.	30	7.20 NM	4.00

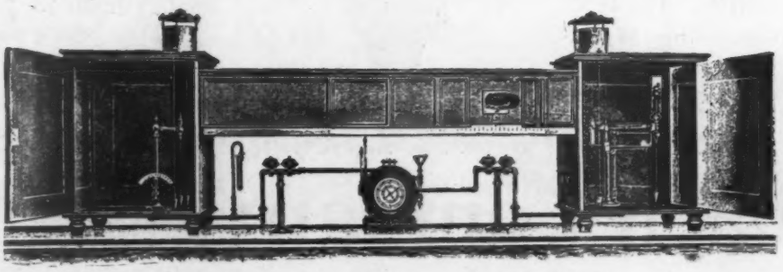
TOTAL HOURS DURING 1908.

By Table No. 1.

	Hrs.Min.
January	228.30
February	187.30
March	192.00
April	160.10
May	155.10
June	138.00
July	155.50
August	173.40
September	185.20
October	214.00
November	218.10
December	226.40
Total, yr.	2235.00







Closed Photometer For Light Room.

CIRCULARS SENT ON REQUEST.

PUBLIC LIGHTING TABLE.

APRIL, 1908.

Day of Week.	Date.	Table No. 2. New York City. All Night Lighting. Complete Lighting in One Hour From Time Given P. M.	Complete Extinguishing in 50 Minutes From Time Given A.M.
Wed.	1	5.57	4.47
Thu.	2	6.07	4.37
Fri.	3	6.07	4.37
Sat.	4	6.07	4.37
Sun.	5	6.07	4.37
Mon.	6	6.07	4.32
Tue.	7	6.07	4.32
Wed.	8	6.07	4.32
Thu.	9	6.17	4.22
Fri.	10	6.17	4.22
Sat.	11	6.17	4.22
Sun.	12	6.17	4.22
Mon.	13	6.17	4.22
Tue.	14	6.17	4.22
Wed.	15	6.17	4.22
Thu.	16	6.27	4.17
Fri.	17	6.27	4.17
Sat.	18	6.27	4.17
Sun.	19	6.27	4.12
Mon.	20	6.27	4.12
Tue.	21	6.27	4.12
Wed.	22	6.27	4.12
Thu.	23	6.37	4.02
Fri.	24	6.37	4.02
Sat.	25	6.37	4.02
Sun.	26	6.37	4.02
Mon.	27	6.37	4.02
Tue.	28	6.37	4.02
Wed.	29	6.37	4.02
Thu.	30	6.47	3.52

TOTAL HOURS DURING 1908.

	Hrs.Min.
January	481.50
February	329.15
March	351.50
April	341.50
May	233.05
June	218.10
July	282.55
August	254.55
September	292.25
October	420.45
November	374.30
December	411.05
	3992.35
Deduct on account of 50 min. extinguishing time	30.30
Total, yr.	3962.05

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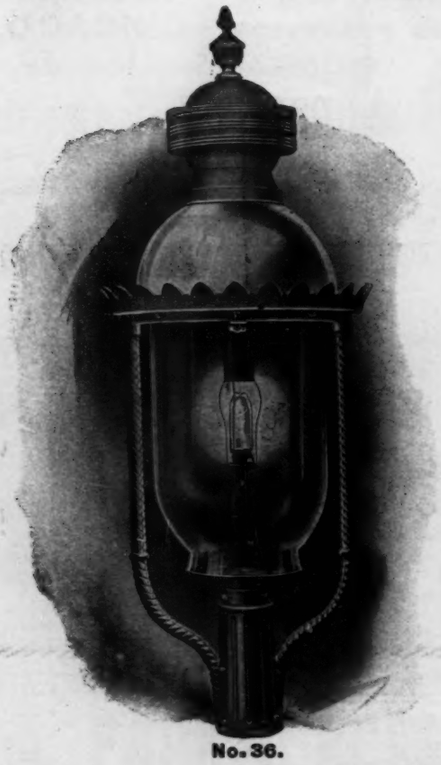

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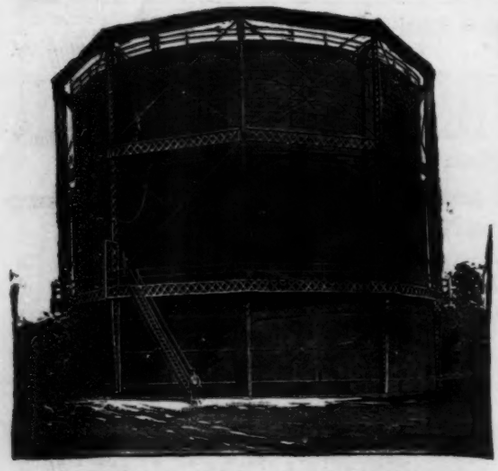

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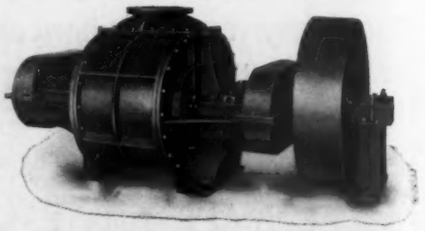

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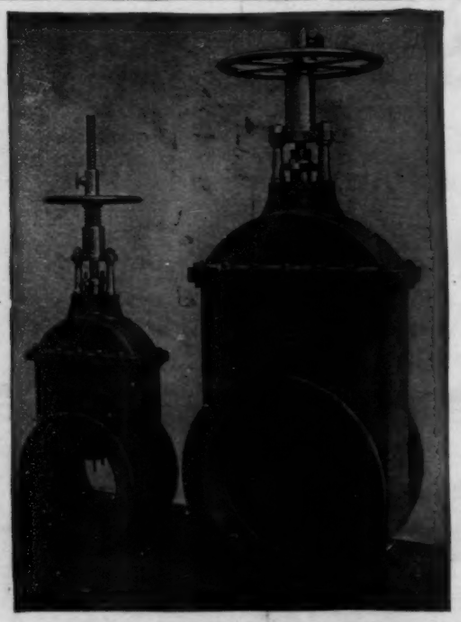

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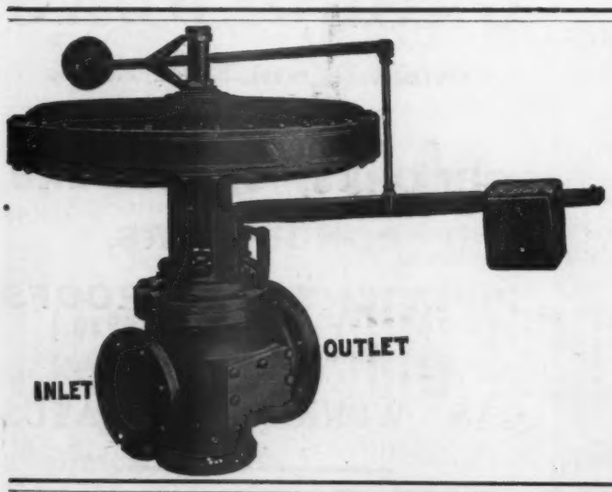

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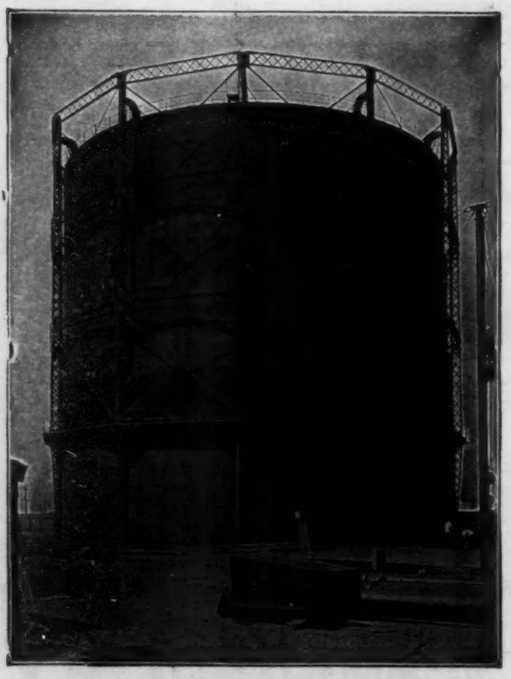

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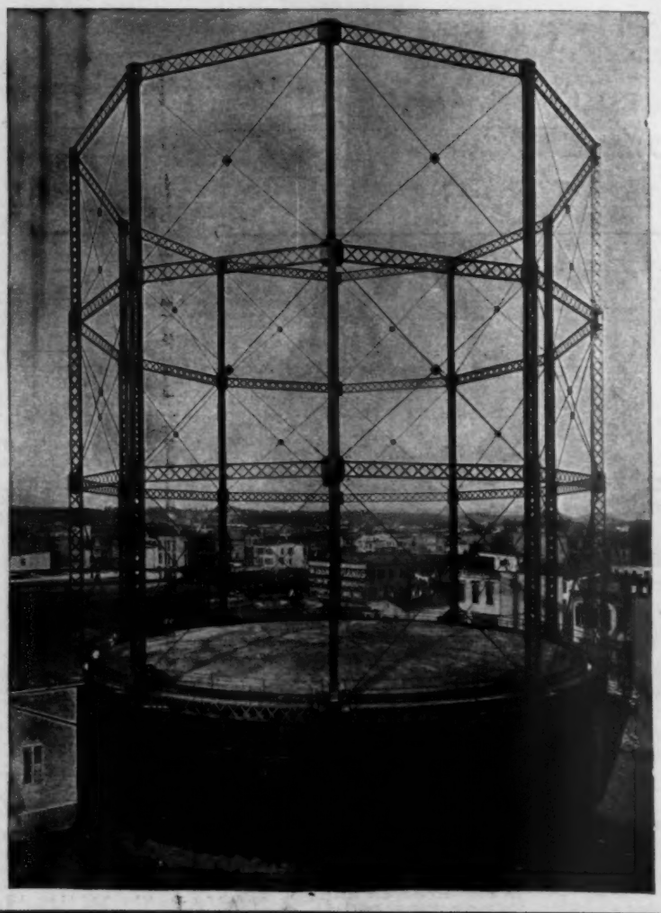

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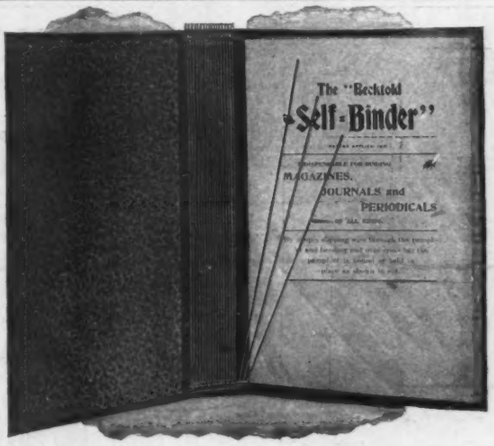

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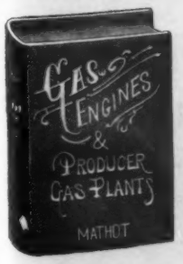

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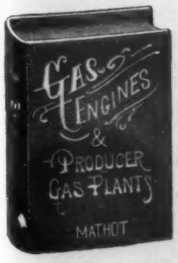

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